Chances of Increasing Youth Health Awareness through Mobile Wellness Applications

Andreas Holzinger[1,2], Stefan Dorner[1,2], Manuela Födinger[3], André Calero Valdez[4], and Martina Ziefle[4]

[1] Medical University Graz, A-8036 Graz, Austria
Institute for Medical Informatics (IMI), Research Unit HCI4MED
[2] Graz University of Technology, A-8010 Graz, Austria
Institute for Information Systems and Computer Media (IICM)
andreas.holzinger@medunigraz.at,
sdorner@student.tugraz.at
[3] Kaiser Franz Josef Spital, A-1100 Wien, Institut für Labordiagnostik
manuela.foedinger@wienkav.at
[4] RWTH Aachen University, D-52056 Aachen, Human Technology Centre (Humtec)
{ziefle,calero-valdez}@humtec.rwth-aachen.de

Abstract. The poor general state of health of the Austrian youth – which is possibly representative for the western industrial world – will have dramatic effects on our health care system in years to come. Health risks among adolescents, including smoking, alcohol, obesity, lack of physical activity and an unhealthy diet, will lead to an increase in chronic diseases. A preventive measure against such a development could be to reinforce health awareness through the use of web and mobile applications supporting self observation and behavior change. In this paper, we present an overview of the latest developments in the area of mobile wellness and take a look at the features of applications that constitutes the current state of the art, as well as their shortcomings and ways of overcoming these. Finally, we discuss the possibilities offered by new technological developments in the area of mobile devices and by incorporating the characteristics that make up the Web 2.0.

Keywords: Wellness, Health, mobile computing, self-observation, behavior change, Web 2.0, prevention.

1 Introduction and Motivation for Research

The poor general state of health of Austrian youths will have dramatic effects on our health care system in the future. According to Chini & Dorner from the Austrian Medical Association [1] we will have to face additional costs of 1.6 billion Euros in 2030, increasing to 3.7 billion Euros in 2050.

This will be mainly due to smoking, alcohol, obesity, lack of physical activity and insufficient consumption of fruit, leading to common diseases such as diabetes, hypertension, myocardial infarction, stroke, renal insufficiency, osteoporosis and chronic back. *"Today's unhealthily living youths will be tomorrow's chronically ill",* as

G. Leitner, M. Hitz, and A. Holzinger (Eds.): USAB 2010, LNCS 6389, pp. 71–81, 2010.

Dr. Walter Dorner, president of the Austrian Medical Association pointed out. This trend will not only lead to increased costs in health care, but it will also result in a lack of available manpower in the job market. As suggested by Chini, these costs should better be reallocated to preventive costs. Through successful prevention, health care costs arising from people older than 65 can be reduced significantly.

A preventive measure against such a development can be by enforcing a permanent change in the lifestyle and health-awareness of adolescents by the use of wellness management and self-observation. Such measures fit well into the description of the health continuum by Saranummi [2], who emphasizes the advantage of proactive management of health and illness compared to reactive action. Saranummi also states that the provision of knowledge and tools for self-management is another important part of the health continuum. This can be achieved through the use of wellness applications that offer their end users assistance in performing self-observation and motivate them to improve their lifestyle over a long-term period. Mobile applications offer some important advantages for this task such as pervasive and permanent availability. In this paper we take a look at the current state of the art in the area of mobile wellness supporting applications.

We describe some features of current applications, the technologies used, as well as the shortcomings these applications may hold and ways of overcoming these. We also take a look at new technological developments in the area of mobile devices and the possibilities they provide, combined with the characteristics that make up the Web 2.0, they offer in the invention of new wellness supporting applications.

2 Related Work: Applications Supporting Health Awareness

During the last years several web and mobile applications have been developed with the aim of supporting self-care. Most of these applications were intended to be used by chronic disease patients, but the main goal of motivating their users to a healthier lifestyle can also be applied to young, healthy individuals. The technologies used for these applications ranged from web services and web applications using RIA (rich internet application) methods to client side technologies such as the Java2 Micro Edition (J2ME) and native client device applications.

2.1 Personal Health Applications

Personal Health Applications (PHAs) allow users to store and manage their personal health information, thereby supporting patient empowerment and facilitating the flow of information between patients and health care providers.

Along with the users' personal data the application can store a variety of health related data like laboratory medical conditions, test results, medications and allergies. Amongst the most prominent of these applications are Google Health, Microsoft HealthVault or LifeSensor. Microsoft's solution puts special effort on the possibility to connect to external health devices inclduding blood pressure monitors, pedometers, glucometers. The main strengths of Google Health are it its ability to connect to external health providers such as hospitals in order to integrate their data as well as the possibility for external applications to access Google Health functions through the Health Data API.

Andry et al (2008), [3] created LifeSensor Diabetes, a web application which is built atop the LifeSensor Personal Health Record (PHR) and the ICW eHealth Framework. Users can start using the application by filling in basic profile information (gender, age, height, weight). They can also specify personal targets for specific diabetes markers. Data that already exist in the user's PHR on LifeSensor can be imported, new data are entered regularly. Since the ICW eHealth Framework supports device integration, the project is working on implementing automatic data gathering from glucometers. The application aims to motivate its users to access their application regularly, so much effort is put into high interactivity und good usability features. To achieve this, modern web technologies including AJAX and FLEX were used for implementing the client application [4], [5]. Another motivating feature is the possibility for users to define action plans that provide them the possibility to plan and track their progress towards achieving defined personal goals.

Analyzing the granularity of the visualized observations showed, that data differed in both the frequency of measurement and the types of values [6]. Some data has to be measured several times a day, while other data will be measured on a yearly basis. The different types of values were assigned to two different types of graphs: health targets (e.g. blood glucose or cholesterol) can be represented using 2D line charts and candle-like charts, activities (e.g. exercise, diet or medication) were assigned ordinal values (poor, fair, good, very good) and displayed using histograms. The visualization itself is handled by a generic graph container which can display one or two modules out of eight currently implemented modules (exercise, diet, medication, blood glucose, weight, cholesterol, HbA1c, blood pressure / heart rate). By displaying two modules inside the same container and synchronizing their time axis, data correlations can be discovered visually.

2.2 Mobile Applications Supporting Wellness

The rapid improvement of mobile devices regarding their usability and their technological abilities as well as their high pervasiveness and availability makes them a popular platform for wellness supporting applications. The Wellness Diary as described by [7], [8] is a mobile application that can be used for recording and managing personal health data. The system is able to monitor weight, exercise, diet, alcohol usage, sleep, smoking, stress and step data per default, but it is also customizable, so users are able to adapt the data model to their needs and preferences. The mobile application is no web application but a standalone application storing the data, which is manually entered by the user, on the mobile device itself.

The developers also created a web service counterpart to the mobile application that allows for data synchronization between the mobile device and a central server.

iBody [9] is a commercial iPhone application and makes use of the GPS functionality provided by the iPhone. The application allows to monitor various sportive activities including running or cycling. GPS is used in order to track the covered route and distance. The measured distance combined with information about the type of activity and the user's weight can then be used to calculate the calorie consumption. It is also possible to view the route covered in Google Maps. Similar to other wellness supporting applications, one can enter health related data, e.g. body weight, adipose, blood pressure, pulse or blood-test results and offers graphical reports of these.

2.3 Mobile Applications for People with Chronic Diseases

The majority of mobile health supporting applications found, are not aimed at supporting healthy people in their daily wellness related activities but rather in supporting people with chronic diseases and people recovering from certain illnesses. Despite the different target groups, their goals, namely patient empowerment and motivation, are largely the same.

Walters et al. (2010) [10] developed a mobile application, based on Wellness Diary used for home-based care of cardiac rehabilitation patients. The application is able to monitor blood pressure through an external device and to estimate physical activity through a step counter provided by the mobile phone. Additionally to these automatically measured data the patients can manually enter other parameters like weight, body fat percentage, additional exercise information, stress, sleep times and tiredness as well as nutritional, smoking and alcohol consumption information. Weekly consultations with their mentor who is able to access all entered data helps in setting reasonable goals and discuss the progress toward recent goals. The project also makes use of motivational and multimedia messages provided by the mentor through the mobile phone. The mentored phase lasts for 6 weeks but the patients are encouraged to keep using the application for self management.

The Confidant system by [11] is another mobile application used for chronic disease management. Similar to the cardiac rehabilitation application by [10] it combines collected (blood glucose, blood pressure, weight) and manually entered (count, customized questions) data with the informative messages provided on a daily basis. The application consists of two communicating modules, a native client-side program and a server application running on a web server.

A rich internet application (RIA) developed by [12] and usable on handheld devices aims to bring modern RIA technology into the fields of telemedicine and mobile health. Their web based application enables a communication path between handheld devices and hospital information systems.

Some of their main aims for this system were to enable access to medical data, to tele-consultation as well as to educational means.

By creating a web based application suited to be used by mobile devices, no installation on the client side was required and the application was independent of platform and hardware. Due to the outsourcing of application logic to the mobile client less network traffic was needed and the server side application gained higher scalability. The main technologies used were a content management system (CMS) using Adobe Flex and a mobile application using the Flash Lite platform.

The Diabetes Living Assistant by Calero-Valdez et al. [13], [14] is a diabetes management program developed with Java2ME for mobile devices.

It includes a diabetes diary, health parameter-tracking, BE-calculator and a reminder tool for medical intake. It also includes graphical analyses for key health factors. The diabetes diary goes beyond simple tracking and logging of glucose readings and food intake by suggesting adjusted insulin dosages in regard to current glucose measurement, activity level and planned eating, thus simplifying the patients tedious calculations for everyday insulin administration (see Fig. 1).

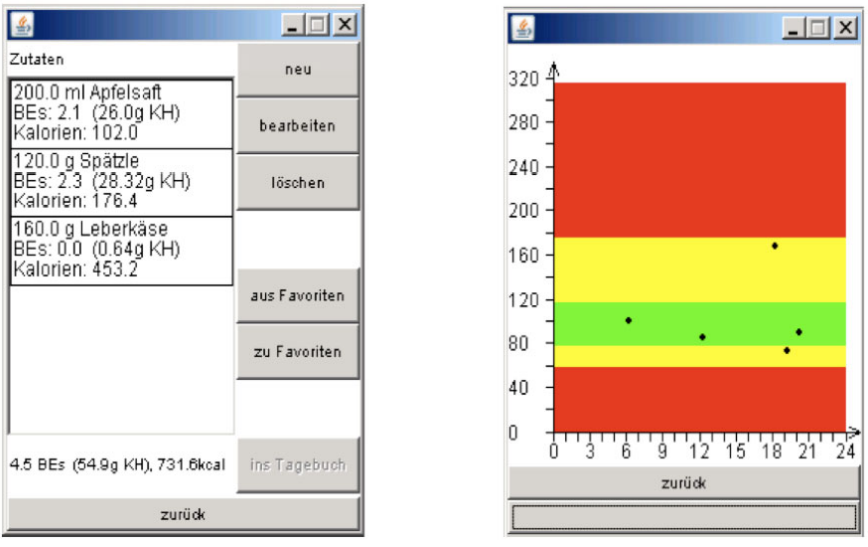

Fig. 1. Screenshots of the Diabetes management program showing the "Favorite Dishes" (left) and "Graphical Analysis" (right) function of the device

BE-calculations are also simplified by allowing users to store and retrieve favorite dishes and use them in the diary. In order to ease switching from paper-based tracking to a mobile device, user interface layouts are based on the commonly used paper-based diabetes diaries. Acceptance testing of a prototype of the Diabetes Living Assistant yielded good acceptance rates [15].

3 Potential for Improvement

3.1 Results from User Studies on Wellness Applications

A number of user experience studies on Wellness Diary [16], [17], [18] and [19] have been performed and [20] present concepts to improve the application based on the received feedback. One of their main improvement aims was to increase the long-term motivation of their users. Furthermore, many users did not use the application regularly due to forgetfulness or during their holidays. According to the authors, long-lasting motivation could be achieved by making the application generally more enjoyable to use. Another flaw of current wellness applications was the users' effort of entering wellness data that was by far too high as compared to the results obtained from the application. Features that could increase the motivation of the users might be alarms, rewards and detailed analysis of the user data. A high level of interactivity is also regarded as a good means of motivating users to continue using the wellness application.

Regarding user support by mentors, the study done by [17] showed two different user positions. While some users preferred to use the application privately, others would welcome professional feedback on their data. Considering this result, wellness

supporting applications should allow the possibility of professional feedback but not force it onto its users.

3.2 Impact of New Technologies

Considering the rapid advancement in mobile technologies, using a web application instead of an application running on the client device will increase the number of applicable mobile devices to all offering a supported browser. By using rich internet application (RIA) technology the application can offer the look and feel of a pure client side application. Another advantage of this approach is that no installation on the mobile device by the user will be necessary. As opposed to this approach is the concept of apps, offered by modern smart phones such as the iPhone or phones running Google's Android – native applications that can be easily acquired through online app stores. Developing such native apps allows the application to better utilize the mobile device's abilities but makes porting it to other devices more difficult.

As described by [21], new emerging interface technologies including multi-touch and low priced sensors will make user interaction a much more enjoyable feature of new developments. Gesture-based devices including the Nintendo Wii, built-in pedometers and GPS enabled mobile devices offer new possibilities of integrating physical activity into future wellness applications. Similar to the utilization of a step counter by the application developed by [10], new tools may use GPS to track the user's running activity, including speed and distance. The W3C Geolocation API [22] provides support for retrieving and working with location information inside web pages using JavaScript and is already supported by the major browsers.

This location information can not only be retrieved from IP addresses but can also utilize GPS data as provided by many mobile devices. Employing these new ways of gathering activity data can significantly decrease the effort of entering wellness relevant data into a mobile device.

In March 2010 Nintendo released two games (Pokémon HeartGold and Pokémon SoulSilver) for their mobile gaming platform Nintendo DS that require the usage of a pedometer for game success and is aimed at the younger audience (ESRB-Rating: E). The player takes out one of his virtual pets on a walk in order to train the pet to become stronger inside the game and to earn virtual currency within the game. Players can also engage in competition with each other comparing the strength of their virtual pets. Bayer also released a Nintendo DS game, which in conjunction with a special glucosemeter, teaches children with diabetes good glucose testing habits. Regular testing is rewarded with in-game bonus points that can be redeemed both inside the game and on a social networking site for kids with diabetes. Effectiveness of educational gaming has been studied with stationary gaming consoles for teaching health related topics in general [23] and for diabetes in particular [24] leading to positive changes in behavior, self-efficacy and communication with parents.

Web 2.0, often also called the "social web", is described by several characteristics [25] including collaborative activity, greater levels of participation and high interactivity as well as high applicability in educational settings [26]. These attributes can be seen in applications including wikis, blogs, podcasts, social bookmarking, collaborative tagging, social networking and online social gaming. These applications can play a significant role in providing more motivational features in wellness supporting applications.

While wikis, blogs, podcasts or social bookmarking can be employed in order to give the user access to information about all aspects of their personal wellness, social networking allows them to share their experience and efforts with other same minded users. Several studies suggest, that peer groups can have a significant effect on the weight of adolescents, especially of females [27], [28]. Social networks could utilize this effect in order to support a healthier lifestyle. Online social gaming can increase the fun effect of their activities while offering a good opportunity to include a system of goals and rewards, thereby offering strong incentives for a long-term use of the application. A social game with a competitive character about the accomplishment of goals can offer very high motivation to its users.

The combination of the possibilities of modern mobile devices including GPS, cameras or step counters with aspects of Web 2.0 like social networking or social gaming offers very interesting possibilities for future wellness supporting applications. [21] describes Geocaching, an outdoor sport similar to a paper chase game which combines GPS with social gaming in order to create a game encouraging physical activity together with like-minded people.

3.3 Abilities, Motivation and Cognitive Mindsets for Health Awareness

So far, this paper discuss new mobile applications, and devices, which had been developed to support health-related behaviors. The availability of mobile technical solutions is definitively an important way to increase the general health awareness.

However, there is also another component, which should be considered and adequately addressed when designing and developing new health applications and interfaces. However, from a psychological point of view, we should be aware that the usage of (mobile) technology, their success and sustainability, strongly depends on the extent to which human properties -cognitive, affective and motivational aspects- are taken into account. Even though mobile technology and mobile applications are one of the fastest growing industrial sectors ever, considerable friction losses with respect to usability concerns are to be noticed [29], [30], [31]. Users often get stuck and overwhelmed when using technical devices and need to be supported to come to terms with sophisticated technology [32]. The still-present gap between technological genius and usability demands might represent a serious obstacle for the acceptance of technology by a broad user group if not adequately addressed by designers and manufacturers [33]. Devices must meet the demands and cognitive abilities of a broad user group and respond to users' diversity likewise. As long as mobile interface and information designs are not easy to use, technical innovations will not have sustained success. One may argue that the usability problem will vanish whenever the old technically inexperienced generation died off, relying on the idea that children and teens, which have a different technical upbringing and used to technology from early on might less affected by a low interface usability. Even though technical experience is definitively advantageous for device handling, see e.g. [34] it could be shown that especially children and teenagers are highly sensitive for suboptimal user interface design [35], [36]. Facing an increase in the usability of functions announced by manufacturers, this is of central interest. Independently of which and how many functions will be implemented in future devices, Coopers' (1999), [37] warning will have to be exigently followed: 'You can predict which features in any new technology will get used and which not. The usage of features is inversely proportional to the amount of interaction needed to control it' (Cooper, 1999, p. 33).

In addition to the ease of using aspect, mobile health applications should be developed in a way that users want to use it. This seems of specific impact in the context of disease management and health behaviours. Within public perception, the prevalent image of medical technology still is stigmatizing, intrusive, and difficult to use. Also, using medical technology is seen as a necessary evil, and only tolerated when patients do not have any alternatives. In this sense, medical technology is functional, but associated with disease and health deficits [38]. Especially, the implementation of mobile wellness applications requires a broadening of the classical focus and should include emotional or affective designs. In this perspective, the quality of "good interfaces" relies on more than the orientation on mere functional aspects, but the inclusion of hedonic aspects emphasizing individuals' well-being, pleasure and fun [39]. Accordingly, studies show that users desire more than the mere functioning of technology, but prefer interfaces with a high social or hedonic value. Hedonic functions are providing stimulation, identity, and valuable memories [40], [41], [42].

A medical application or device, which is joyful to use, which is elegant and "cool", would definitively increase the motivation for using it and the compliance behaviors regarding health and disease management.

By combining positive characteristics and human desires with medical engineering, the medical application would be redefined from being a marker of shortcomings and deficits to a driver of individual quality of life decisions [38].

A vivid and very convincing example for such an approach can be seen is the piano staircase (http://www.thefuntheory.com/piano-staircase). The grounding question of this showcase was whether we can we get more people to choose the stairs over the escalator by making it fun to do. The on-site scene is at a Swedish underground stop over, at which the stairs were transformed to huge piano keys. Each step on these keys resulted in a tone. The question whether hedonic interfaces would motivate people to behave „healthy" by choosing the stairs over the escalator can be clearly answered. 66% more people chose the stairs, and the video clips taken from there show that the enthusiasm about choosing the stairs was high, independently of the age and culture of the pedestrians.

4 Conclusion

Supporting adolescents in leading a healthier lifestyle is an essential preventive measure against the development of chronic diseases. This proactive way of health management can be an important factor in the reduction of future health care costs. One way of providing this support can be through the use of a mobile application. Mobile devices offer the advantage of high pervasiveness, especially in our target group of adolescents. There are already a number of applications for personal health support like Personal Health Applications, mobile applications for persons with chronic diseases and also some mobile wellness supporting applications. A very important factor for the success of such applications is their ability to motivate people to use them constantly and over a long time. The combination of aspects of Web 2.0 like social networking or social gaming with technological features of mobile devices like GPS, cameras or step counters offers very interesting possibilities for making wellness supporting applications motivating and even fun to use for young people.

References

1. Chini, L. W., Dorner, W.: Kranke Kinder, was tun? Bessere Prävention macht auch Volkswirtschaft gesünder, Pressetext 2010-03-23, http://www.aerztekammer.at (last access: 2010-08-19)
2. Saranummi, N.: IT applications for pervasive, personal, and personalized health. IEEE Transactions on Information Technology in Biomedicine 12(1), 1–4 (2008)
3. Andry, F., Freeman, L., Gillson, J., Kienitz, J., Lee, M., Naval, G., Nicholson, D.: Highly-Interactive and User-Friendly Web Application for People with Diabetes. In: IEEE International Conference on Communication Systems, HEALTHCOM 2008, pp. 118–120 (2008)
4. Holzinger, A., Hoeller, M., Bloice, M., Urlesberger, B.: Typical Problems with developing mobile applications for health care: Some lessons learned from developing user-centered mobile applications in a hospital environment. In: Filipe, J., Marca, D.A., Shishkov, B., Sinderen, M.v. (eds.) International Conference on E-Business (ICEB 2008), pp. 235–240. IEEE, Los Alamitos (2008)
5. Holzinger, A., Mayr, S., Slany, W., Debevc, M.: The influence of AJAX on Web Usability ICEB, pp. 124–127. IEEE, Los Alamitos (2010)
6. Mandryk, R.L., Atkins, M.S.: A fuzzy physiological approach for continuously modeling emotion during interaction with play technologies. International Journal of Human-Computer Studies 65(4), 329–347 (2007)
7. Koskinen, E., Sahninen, J.: A customizable mobile tool for supporting health behavior interventions. In: 2007 Annual International Conference of the IEEE Engineering in Medicine and Biology Society, vol. 1-16, pp. 5908–5911. IEEE, Los Alamitos (2007)
8. Yang, Y.: The design and implementation of a Web mobile-based behavior change application system. In: 5th International Conference on Information Technology and Applications in Biomedicine (ITAB 2008) in Conjunction with 2nd International Symposium & Summer School on Biomedical and Health Engineering (IS3BHE 2008), pp. 491–494. IEEE, Los Alamitos (2008)
9. Welsch, H., Müller, K.: iBody, http://www.ihanwel.com/?page_id=269 (last access: 2010-08-19)
10. Walters, D.L., Sarela, A., Fairfull, A., Neighbour, K., Cowen, C., Stephens, B., Sellwood, T., Sellwood, B., Steer, M., Aust, M., Francis, R., Lee, C.K., Hoffman, S., Brealey, G., Karunanithi, M.: A mobile phone-based care model for outpatient cardiac rehabilitation: the care assessment platform (CAP). BMC Cardiovascular Disorders 10 (2010)
11. Katz, D.L., Nordwall, B.: Novel interactive cell-phone technology for health enhancement. Journal of Diabetes Science and Technology 2(1), 147–153 (2008)
12. Constantinescu, L., Pradana, R., Kim, J., Gong, P., Fulham, M., Feng, D.: Rich internet application system for patient-centric healthcare data management using handheld devices EMBC. In: 2009 IEEE Engineering in Medicine and Biology Society, pp. 5167–5170 (2009)
13. Calero-Valdez, A., Ziefle, M., Alagöz, F., Holzinger, A.: Mental Models of Menu Structures in Diabetes Assistants. In: Miesenberger, K., Klaus, J., Zagler, W., Karshmer, A. (eds.) ICCHP 2010. LNCS, vol. 6180, pp. 584–591. Springer, Heidelberg (2010)
14. Calero Valdez, A., Ziefle, M., Horstmann, A., Herding, D., Schroeder, U.: Effects of Aging and Domain Knowledge on Usability in Small Screen Devices for Diabetes Patients. In: Holzinger, A., Miesenberger, K. (eds.) USAB 2009. LNCS, vol. 5889, pp. 366–386. Springer, Heidelberg (2009)

15. Calero-Valdez, A., Ziefle, M., Schroeder, U., Horstmann, A., Herding, D.: Task performance in mobile and ambient interfaces. In: IEEE International Conference of the I-Society, Does size matter for usability of electronic diabetes assistants? Full paper at the, IEEE (2010) (in press)
16. Mattila, E., Korhonen, I., Lappalainen, R., Ahtinen, A., Hopsu, L., Leino, T.: IEEE, Nuadu Concept for Personal Management of Lifestyle Related Health Risks. In: 2008 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, vol. 1-8, pp. 5846–5850. IEEE, Los Alamitos (2008)
17. Mattila, E., Parkka, J., Hermersdorf, M., Kaasinen, J., Vainio, J., Samposalo, K., Merilahti, J., Kolari, J., Kulju, M., Lappalainen, R., Korhonen, K.: Mobile diary for wellness management - Results on usage and usability in two user studies. IEEE Transactions on Information Technology in Biomedicine 12(4), 501–512 (2008)
18. Ahtinen, A., Ramiah, S., Blom, J., Isomursu, M.: Design of mobile wellness applications: identifying cross-cultural factors. In: Proceedings of the 20th Australasian Conference on Computer-Human Interaction: Designing for Habitus and Habitat, pp. 164–171 (2008)
19. Ahtinen, A., Mattila, E., Vaatanen, A., Hynninen, L., Salminen, J., Koskinen, E., Laine, K.: User experiences of mobile wellness applications in health promotion: User study of Wellness Diary, Mobile Coach and SelfRelax Pervasive Computing Technologies for Healthcare. In: 3rd International Conference on Pervasive Health 2009, pp. 1–8 (2009)
20. Mattila, E., Korhonen, I., Salminen, J.H., Ahtinen, A., Koskinen, E., Sarela, A., Parkka, J., Lappalainen, R.: Empowering Citizens for Well-being and Chronic Disease Management With Wellness Diary. IEEE Transactions on Information Technology in Biomedicine 14(2), 456–463 (2010)
21. Falchuk, B.: Visual and interaction design themes in mobile healthcare. In: 2009 6th Annual International Mobile and Ubiquitous Systems: Networking & Services, MobiQuitous 2009, pp. 1–10. IEEE, Los Alamitos (2009)
22. Popescu, A.: Geolocation API Specification, `http://www.w3.org/TR/geolocation-API/` (last access: 2010-08-19)
23. Lieberman, D.A.: Interactive video games for health promotion: Effects on knowledge, self-efficacy, social support, and health. In: Street, R.L., Gold, W.R., Manning, T. (eds.) Health Promotion and Interactive Technology: Theoretical Applications and Future Directions. Lawrence Erlbaum, Mahwah (1997)
24. Brown, S.J., Lieberman, D.A., Gemeny, B.A., Fan, Y.C., Wilson, D.M., Pasta, D.J.: Educational video game for juvenile diabetes: Results of a controlled trial. Medical Informatics 22(1), 77–89 (1997)
25. Ward, R., Moule, P., Lockyer, L.: Adoption of Web 2.0 Technologies in Education for Health Professionals in the UK: Where are we and why? Academic Conferences Ltd., Reading (2008)
26. Holzinger, A., Kickmeier-Rust, M.D., Ebner, M.: Interactive Technology for Enhancing Distributed Learning: A Study on Weblogs. In: HCI 2009 The 23nd British HCI Group Annual Conference, pp. 309–312 (2009)
27. Trogdon, J.G., Nonnemaker, J., Pais, J.: Peer effects in adolescent overweight. Journal of Health Economics 27(5), 1388–1399 (2008)
28. Renna, F., Grafova, I.B., Thakur, N.: The effect of friends on adolescent body weight. Economics & Human Biology 6(3), 377–387 (2008)
29. Ziefle, M., Bay, S.: How older adults meet complexity: aging effects on the usability of different mobile phones. Behaviour & Information Technology 24(5), 375–389 (2005)
30. Ziefle, M., Bay, S.: How to overcome disorientation in mobile phone menus: A comparison of two different types of navigation aids. Human Computer Interaction 21(4), 393–432 (2006)

31. Holzinger, A., Searle, G., Kleinberger, T., Seffah, A., Javahery, H.: Investigating Usability Metrics for the Design and Development of Applications for the Elderly. In: Miesenberger, K. (ed.) ICCHP 2008. LNCS, vol. 5105, pp. 98–105. Springer, Heidelberg (2008)
32. Ziefle, M., Bay, S.: Transgenerational Designs in Mobile Technology. In: Lumsden, J. (ed.) Handbook of Research on User Interface Design and Evaluation for Mobile Technology, pp. 122–140. IGI Global (2008)
33. Arning, K., Ziefle, M.: Barriers of information access in small screen device applications: The relevance of user characteristics for a transgenerational design. In: Stephanidis, C., Pieper, M. (eds.) ERCIM Ws UI4ALL 2006. LNCS, vol. 4397, pp. 117–136. Springer, Heidelberg (2007)
34. Ziefle, M.: The influence of user expertise and phone complexity on performance, ease of use and learnability of different mobile phones. Behaviour & Information Technology 21(5), 303–311 (2002)
35. Bay, S., Ziefle, M.: Children Using Cellular Phones. The Effects of shortcomings in user Interface Design. Human Factors 47(1), 158–168 (2005)
36. Bay, S., Ziefle, M.: Landmarks or surveys? The impact of different instructions on children's performance in hierarchical menu structures. Computers in Human Behavior 24(3), 1246–1274 (2008)
37. Cooper, A.: The Inmates are Running the Asylum: Why High-Tech Products Drive Us Crazy and How to Restore the Sanity. Sams, Indianapolis (IN) (1999)
38. Borchers, J., Jakobs, E.-M., Ziefle, M., Russell, P., Schmitz-Rode, T.: Health@Home. Technology supporting personal quality of life decisions. White Paper at RWTH Aachen University, Germany (2010)
39. Ziefle, M., Jakobs, E.-M.: New challenges in Human Computer Interaction: Strategic Directions and Interdisciplinary Trends. In: 4th International Conference on Competitive Manufacturing Technologies, pp. 389–398 (2010)
40. Hassenzahl, M.: The effect of perceived hedonic quality on product appealingness. International Journal of Human-Computer Interaction 13(4), 481–499 (2001)
41. Hassenzahl, M.: The Thing and I: Understanding the relationship between user and product. In: Blyhte, M.A., Overbeeke, K., Monk, A.F., Wright, P.C. (eds.) Funology. From Usability to Enjoyment, pp. 31–42. Kluwer, Dordrecht (2004)
42. Wright, P., Mc Carthy, J., Meekinson, L.: Making sense of experience. In: Blyhte, M.A., Overbeeke, K., Monk, A.F., Wright, P.C. (eds.) Funology. From Usability to Enjoyment, pp. 43–53. Kluwer, Dordrecht (2005)