Fröber, Ulrike; Lutherdt, Stefan; Stiller, Carsten, Roß, Fred; Witte, Hartmut; Kurtz, Peter:

The design of a tourist assistance system for several handicapped and elderly

Zuerst erschienen in:
CD-ROM-Ausg.: Meeting diversity in ergonomics : proceedings IEA 2006 congress / ed. by R. N. Pikaar ... - Amsterdam [u.a.] : Elsevier. - 2006, insges. 5 S.

The design of a tourist assistance system for several handicapped and elderly

U. Fröber[a], S. Lutherdt[a], C. Stiller[b], F. Roß[b], H. Witte[a], P. Kurtz[c]

[a] *Department of Biomechatronics, Faculty of Mechanical Engineering, Technische Universität Ilmenau*
[b] *Department of System Analysis, Faculty of Informatics and Automation, Technische Universität Ilmenau*
[c] *Department of Working Science, Faculty of Mechanical Engineering, Technische Universität Ilmenau*

Abstract

By use of knowledge from biomedical engineering, ergonomics, information and communication technologies as well as from robotics and mechatronics an assistance system for several handicapped and elderly is in development. The aim of the project called "TAS" (Tourist Assistance System) was the development and exemplary assembly of an assistance system for people with impairments as an access support to previously bad or not reachable tourism offers. It was implemented into a chosen model region in Thuringia / Germany. One of the main principles in this project was to use, combine and adapt market available components of the abovementioned technical areas. In this paper the design process of the assistance system and its main components and functions are described.

Keywords: assistance system, ergonomic system design, handicapped, elderly, tourist

1. Introduction

The structures of our society are changing. In future there will be more elderly people grown up with technical devices and knowing the advantages of this kind of support. Also people with diverse impairments avail technical devices in daily life. These facts open a new filed of opportunities for integration of elderly and handicapped and for improving accessibility to tourism offers.

It is important to know the abilities and wishes of future users while developing assistance systems. This provides the requirements of system design. Technical devices used as components of the system should fit these requirements to support human habits. The technical components of "TAS" allow a large degree of free movement in nature for the addressed users.

At the beginning of the project the focus was set on people with visual impairments. In the course of work hearing and motor impaired persons were involved and the system was extended to their needs. Aging entails sometimes problems that are similar to those derived in the three groups of impairments. So the requirements to an assistance system for elderly are similar.

This assistance system mainly consists of the following parts:

1. Components for mobile guiding, navigation and tracking
2. An information data base with decision modules, route planning and communication procedures
3. Web-conformable formatted information, input forms for service providers in tourism and accessible display modules for mobile devices, stationary terminals and internet PCs

These main parts are linked together by common

communication technologies with established safety strategies. So some base modules (like display routines or web forms) are used for mobile devices as well as for stationary and internet terminals.
Because of the special conditions and requirements of the future users the main focus was pointed to the determination of the requested functions and the associated design criteria for the user-focused components of the system.

2. Design process

Lutherdt [1] shows, that to establish such an assistance system into a user environment successfully, requirements have to be analysed and intensive explorations have to be made. From the ergonomic point of view it was a challenge in system design to have such an inhomogeneous user group. 6.7 million people with disabilities live in Germany. 500.000 of them are visually impaired, 155.000 are blind, 250.000 have speech disorders, defective hearing or disturbances of equilibrium. More than 100.000 are paraplegic and have to use a wheelchair [2].

A common process in ergonomic system design is to use an iterative development phase. To avoid such a long term process and because of the special situation an extensive requirement analysis was made. The known lifecycle for usability design processes was shortened with focus on the following main points:

- creation of user profiles
- task analysis
- find common design principles for assistance systems
- design and installation of specific user interfaces

The system is especially developed for people with special needs. Because of the differences in the user group it was necessary to adapt common design principles to their requirements and abilities. Although general design principles for assistance systems for people without impairments are basis of the development.

2.1. Resulting general design principles

Main principle of "TAS" is to use components that are available on the market. These components are to be found in communication, information and media technology, medical engineering, robotics and defence.

Existing rules and barrier-free information offers (constructive and in content) have to be incorporated in the new system.

For the users with sensory impairments it is important to support the intact sense and to find other ways to present information. That means to present important information auditory for visually impaired and visually for auditory impaired persons. For both groups it makes sense to have a haptic interface (e.g. via vibration) [1].
These general design principles have to be considered for all hardware and software components, especially in graphical user interfaces.

3. System Components

The technical components of "TAS" allow a large degree of free movement in nature. By the system the user is able to plan and realise journeys that fulfil his special requirements. The main parts of the system are shown in Fig. 1.

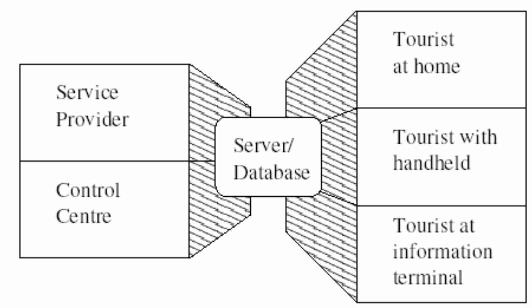

Fig. 1: TAS system components [3]

3.1. Internet presence and stationary info terminal

Starting point of the system use is the user at home or in a tourist office. There he can contact a website where he gets information about accommodation, hiking routes, recreation offers and other things connected to his journey. While using the website a user profile is created. It contains a description of his abilities, used aids, wishes and requirements. The information is gotten by asking direct questions and indirect via additional given information. Later in his vacation the tourist has the chance to identify itself and to use its profile again. In the model region he can use stationary info terminals to concretise and complete the input data.

3.2. Handheld device

In the travelling region the tourist can borrow a handheld device which is a common personal digital assistant (PDA) in a tourist office or hotel. This handheld can guide the persons on hiking tours and it gives information about existing obstacles on the way. The PDAs are connected to servers and the data base where the user profile is stored. So the tourist can log into the system and use the advantages of his personal settings. The connection to the servers via GPRS/ UMTS while hiking provides the possibility of many other services. For example the user can get weather information, call a taxi or set an emergency call.
For several users it is necessary and desired to have a medical monitoring. By connecting some sensors via Bluetooth it is possible to control the physical status of the person.

3.3. Control centre

Another important part of "TAS" is the control centre which has to fulfil the following main tasks:

- observe parameters of the tourists if necessary, for example current position and medical data
- manage emergencies and problems of the users
- observe parameters of the system, for example network connections and battery status
- collect and structure information from service providers like restaurant, taxi drivers and museums

3.3. Server and Database

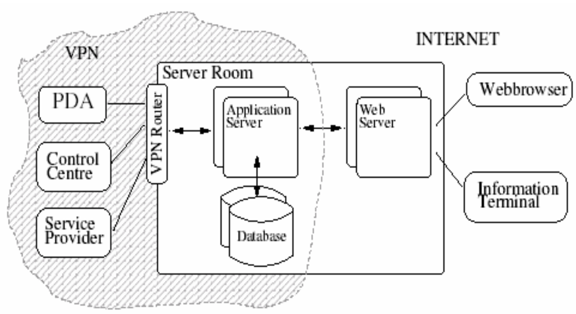

Fig. 2: Server structure [3]

All system components are connected to an application server (see Fig. 2). It provides the backend web interface for the control centre and manages the communication to the mobile devices. A web server running with a Content Management System (CMS) provides the public websites.

An important problem is security. All services for a special user work only within a Virtual Private Network (VPN). The PDAs are connected to this VPN on a low level encrypted GPRS or UMTS access provided by the network operator [3]. All systems inside the VPN are only allowed to communicate with the main server and not with each other or any other terminal. For security reasons there are two redundant servers available. If one does not work the other can take on working automatically.

4. Individualisation

When designing a system for users with certain handicaps it is a challenge to find parameters that can be individualised to fulfil the different needs. Things that can be individualised are user interfaces and especially the software parts of the system.

The information to be displayed are similar. For example all users need route information. But the abilities and requirements of the users to receive them are very different. The handheld device has to be configured based on the saved private user profile. Every user has his own account to log into the system. The adjustment he made for displaying information or how often he gets hints by the system are saved in the data base. While putting in his profile the user answers also indirect questions. So his usual behaviour in a natural environment and his problem solution strategies can be analysed too. The information about the user are not just clinical facts the system also learns about the users private strategies to handle his limitations.
Initial settings of how a user interface is displayed are proposed by a knowledge-based system using fuzzy logic. Often people have more than one handicap so that there is not one clear solution chosen for the user. In this case simple rules like the AND and OR operators can not be used to individualise the system. A solution to realise a decision is using parametric operators. These operators work between the functionality of AND and OR operators. After offline adjustment of those operators the selected setting reflects the needs of the user as good as possible [3]. By using fuzzy logic and special design strategies for software and websites the system components can be individualised.

Another part of individualisation is to integrate these aids the users utilise in their daily life. For reading websites visually impaired people often use screen readers. It is also possible to connect the system to hearing aids that hearing impaired persons use. It is possible to use induction loops what is very common and accepted by the people or to apply new technologies like Bluetooth® (see Fig. 3).

Fig. 3: Bluetooth® adapter produced by Starkey© and a handheld device

Also some all-terrain transportation systems were adapted, and the control of these vehicles and the integration into the assistance system was a challenge for interdisciplinary cooperation.

5. Validation

Fig 4: Members of the BSVT e.V. testing the system

While designing the system the team worked close together with different associations for example the BSVT (Blinden und Sehbehindertenverband Thüringen e.V. – association for visually impaired and blind persons in Thuringia/ Germany) and the DSB (Deutscher Schwerhörigenbund – association for hearing impaired persons in Germany). So future users were involved in the whole process.

A group of visually impaired persons has already tested the system in the model region as shown in Fig. 4. They started a hiking tour guides via the handheld device. The PDA gave instructions about crossings and directions. The system told the users about points of interest and points of navigation. While hiking the current position of the users were transmitted to the main server for analysing the tests later. It was surprising to see that one of the blind users leaded the whole group. He always went in front of the group and gave instructions he got from his handheld.

After the tests the developers and the users discussed the results in smaller groups and analysed the results.

The system has reached a high level of acceptance in this early state. Some further hints were made to improve usability, but the users evaluated the system to be a very good support to reduce barriers and obstacles and to realise access to tourism offers they could not use before.

Another result of the tests is, that the simple graphical user interface that leads users through the menu structures is not only comfortable for visually impaired persons. This interface uses movements on the touch screen that are based on gestures to navigate through the system. Tests showed that this is preferred by all persons tried the use of the system.

6. Discussion

The proposed system takes into concern that a very high level of security and safety is needed in the given application. A breakdown of any of the system components could leave the user without any help. The system is designed as secure as possible but 100% of security can not be guaranteed. The handheld device is able to work without connection to the server. The server structure is build up redundantly. If one of the servers crashes the second one which is always running in hot-standby-mode can take on its functions. For the users it is important to know that they can expect help in any case of emergency. For this reason there is always a human operator in the control centre who can send out help [3].

The problems in using commercial PDA’s as components of the assistance system should not be kept in secret. PDA’s have a lot of not very user friendly features. The touch screen is very small, has limited luminous power and the buttons and cursors are too small for mobile use [6]. Therefore especially people with visually impairments and people with problems in motion can hardly handle them. Things would be easier if speech control would be available. But at the moment the existing software solutions for such a system are too expensive and would overload the limited power of the PDA’s, so that other applications would be restricted in their functionality. Nevertheless the integration of speech control should be prepared just as the development of haptic displays has to be focused.

The described individualisation offers a chance to support people with several handicaps. But the system can be used by everyone without noticing the adjustments that are possible for impaired persons. By this fact “TAS” improves integration of people with handicap and makes daily life more comfortable.

7. Conclusion and Outlook

The continuously contact to the future users enables a fast inclusion of design suggestions. Besides the development and adaptation of special user interfaces for several handicapped and elderly the whole design process has given a benefit for the ergonomic research. During this process a strategy for determining requirements and deploying design criteria for such assistance systems was developed and successfully tested. This strategy allows realising such projects with minimised effort in the future. Core of this strategy is the identification of individual handicaps and strengths and distinctive unattached commonalities of these groups. These extreme peculiarities indicate the range in which assistance is possible and helpful. This assistance system can reach an optimised compromise adaptation to the general conditions of economy, individual history and technical feasibility.

References

[1] Lutherdt S., Fröber U., Wernstedt J., Witte H., Kurtz P. Development of assistance systems for user groups with specific handicaps – a challenge for the ergonomic design process Proceedings of the ISOES 2005, Las Vegas

[2] Statistische Bundesamt Deutschland: Schwerbehinderte Menschen am Jahresende. 2005 Singh B. In: Liu B (Ed.) Probability maps (2nd edn). Springer, Berlin, 1988, pp 154-187.

[3] Stiller C., Roß F., Witte H., A handheld/server based assistance system for tourists with special needs, Proc. Of the IASTED International Conferencce on Advances in Computer Science and Technology (ACST 2006), Mexico

[4] Stiller C., Roß F., Fröber U., Lutherdt S., TAS Tourist Assistance System for usergroups with specific handicaps, Proceedings of the EMBEC 2005, Prague,

[5] Lutherdt S., Fröber U., Witte H., Kurtz P., Wernstedt J., Ergonomische Anforderungen an ein barrierefreies touristisches Assistenzsystem und spezielle Aspekte der Benutzerschnittstelle, Proceedings of the 50th International Scientific Colloquium IWK 2005, Ilmenau

[6] Larni, J. Working with a PDA while walking, Proceedings of the WWCS 2004, Kuala Lumpur