TAS – TOURIST ASSISTANCE SYSTEM FOR USERGROUPS WITH SPECIFIC HANDICAPS

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Abstract: Assistance Systems for elderly and handicapped people guarantee a high level of independence. They also make daily life more comfortable. But most known systems do not take care of obstacle-free access to holiday, leisure time and educational activities. A project to fulfil these aims is the Tourist Assistance System (TAS). It is currently developed within a cooperate project at the Technische Universität Ilmenau. TAS allows a high degree of free movement in nature by using knowledge from biomedical engineering, ergonomics, information- and communication-technologies. The system is designed to take different physical and psychic abilities of its users into consideration.

Introduction

Nowadays society already allows a good integration of bodily impaired people into daily life. A lot of daily tasks which have to be solved in well known urban areas can be achieved by most of the handicapped persons through learning. But it is still a challenge to get along in unknown situations with unexpected barriers. This keeps the most from using offerings of holiday, recreational and educational activities.

In the TAS project an assistance system for mobility impaired people is developed as a contribution for giving equal opportunities in the context of an integrative tourism for everyone. The system shows the functionality within a given model region but can easily be scaled for a bigger area.

Main part of the system is a handheld device which guides the tourist on the hike, comparable to known navigation systems. The approach is to expand this functionality in a way that the system can also be used as an electronic tourist guide. That includes presenting information about points of interest, the menu of the nearest restaurant or even to call a taxi. This happens under the assumption to mind the personal needs and interests of the user. To achieve this goal the device is connected to a server structure that provides up-to-date information and monitors the condition of the device as well as the condition of the user.

System Components

Figure 1 shows the main components of the system that will be explained afterwards.

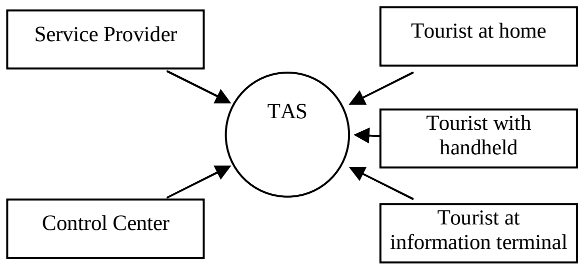

Figure 1: TAS system components

The first impression of the systems possibilities can be obtained through a *website.* Here the user is able to check out all recreation offers, plan hiking routes in advance and even book the according accommodation. While using the website a capability profile of the user is stored to adjust the recommended routes and activities. This is done by asking direct questions and by analysing the users behaviour. This profile is later also used to customise any other access ways to the system.

The website itself can not only be viewed at the internet but also with specially designed information terminals which are set up on basic locations of the model region, i.e. in tourist information offices.

When in the holiday area either a *handheld system* is given to the user or – for walking impaired tourists – a *tablet pc* is mounted to the wheelchair. The system is used as a guide on hikes, where it gives information about the way and possible obstacles but also about interesting landmarks or other points of interest. As mentioned earlier TAS uses a mobile connection to keep the information up to date and to monitor the users state. That gives the possibility to send help in the case of an emergency.

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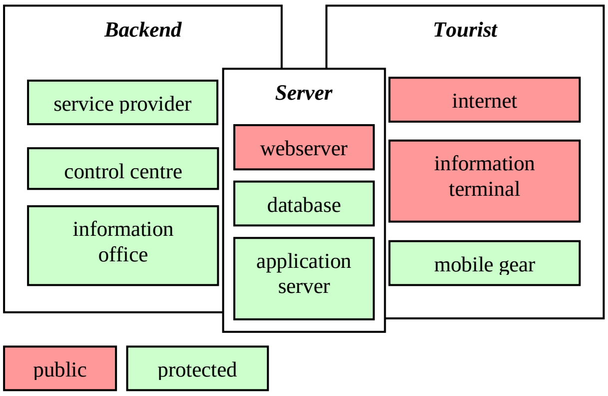

Figure 2: Security concept

To provide the information needed for all of those alternative ways of access to the system a complex *backend/server structure* is required. But as personal data are handled it is also important to consider data security as well as safety issues. Therefore the server functionality is split into two parts as shown in Figure 2. The *public part* is responsible for hosting the website. Anyone is able to browse on this website and look for information about possible holiday activities without giving any information about existing handicaps. More precisely the website does not need to be used by handicapped persons only. As soon as someone is starting to enter personal data, they have to create an own user account, protected by the well known user/password login procedure and SSL encrypted data transfers. With this account any user can plan its own holiday suitable to its own abilities, which includes personalised hiking routes that can be stored and later loaded to the handheld or tablet pc system.

The *protected part* of the server structure is not directly connected to the internet but works only within a Virtual Private Network (VPN). Any mobile gear is connected to this VPN on a low level encrypted GPRS or UMTS access provided by the network operator. Other systems have to use a VPN client software to log in. All systems within this VPN are only allowed to communicate with the main server, a connection between two mobile devices or any other terminal is not allowed. To increase the safety furthermore the main server is set up redundant.

The *main database* is located here, which holds information about the geographical conditions of the area, all tourist attractions, events and services that are provided by third parties and also all necessary information about the user itself.

An other main part of the server functionality is the *routing algorithm*, which pays attention to the personal capability profile of the user. It will select the route to a given destination which contains as less as possible barriers for the user. This algorithm and the determination of the personal capability profile will be described later.

The *administrative backend* of the system takes care of updating all information of the database. While geographical information is rather static, other data must be up to date, i.e. event data, as well as information about road works, temporal closings of museums etc. Another task is the monitoring of tourists which might need medical help. Those backend functions are used either by a control centre or by the service providers itself .

Many other tasks are executed in the background, mainly *statistic analysis*, i.e. of lending frequency, visited points of interests but also to correct geographical data. If critical changes are found a human user is informed to initiate the according actions.

Accessibility

Within this project the term “accessibility” not only applies to selecting the appropriate hiking routes but also to the way information is presented to the user. As a first step blind and seeing impaired persons were focused. This offers the most complex task in finding an adequate way to display information. Handheld computers were chosen as the platform. They can be seen as the best compromise between computing power and manageability outdoors. But those devices still have a lot of insufficiencies that need to be considered. The displays are small, the illumination of the display is either to weak or to power-intense and buttons are to small and hard to find. Off-the-shelf software pays no attention to users that can not read small texts or that can not see at all. [2]

Figure 3: The TAS handheld device

Therefore an User Interface (UI) was implemented that presents the information in at least two sensory channels. The Graphical User Interface consists of easy to recognise items with adjustable colour schemes and font sizes. In addition all functions and operations can be perceived by an audio response. The audio responses level of detail can also be adjusted. Another used output channel is the vibration alarm. The user can be alerted even if he caries the device in his pocket and audio alarms can not be heard.

Attention should also be paid to the user input. The most consequent method would be a speech recognition module. But recent speech recognition algorithm are not robust enough to satisfy the needed accuracy so another handling concept has to be found. Every user input will be achieved by easy to learn gestures on the touch

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screen or – according to the user preference – by using the touch screen like a phone number block that represents different functions on each number. To avoid faulty operation when carried around the device can be set into a locked mode.

The website is designed according to recent guidelines for web design. It uses Cascading Style Sheets (CSS) that can be adopted by the user (i.e. colour scheme or font size.) Also, it accomplishes the needs of users with screen readers or other commercially available reading aids.

The information terminals used in the model region can be used by wheelchair drivers as the touch screen monitor is mounted on a moveable arm, a synthesised voice reads the website for seeing impaired users. The terminal can be operated by the touch screen and four easy to feel knobs besides the monitor.

Personal capability profiles and routing algorithm

As diseases and limitations that have to be considered are versatile it is necessary to set up an capability profile for each user. The information needed to generate such an user profile can be obtained by asking direct as well as indirect questions and by analysing the interests of the user. Also examples of exact situations and scenarios can be used. This procedure emphasises not only the pure clinical facts but also the way a person has learned to cope with his limitations. The profile will be enhanced any time the user is logged on to the system – either on the website or with the handheld device.

The most evident use of this profile is providing adjusted settings for the user interface. Settings like colour scheme, font size and level of detail are set to best fit the needs of the user. This ensures the users ability to use the system without a long setup process. This adjustments are made by a knowledge based system using fuzzy logic. Figures 4 and 5 show an example of how the output on the display can be adjusted to a colour blind user.

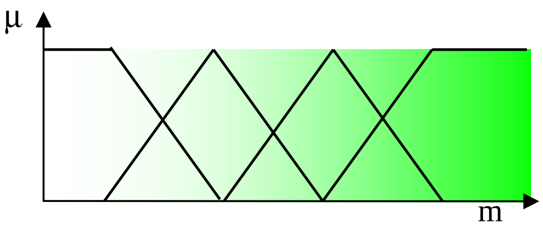

Figure 4: Fuzzy-based setting of colour scheme

Figure 5: Adapted colour scheme for colour blind

Another individualisation of the system is implemented in the route planning and routing algorithm. Main task is to select a route the user is capable to walk. Therefore all barriers have to be mapped to the users capability profile. Again a fuzzy logic based system is used to evaluate what is a barrier and what can be managed by the specific user.

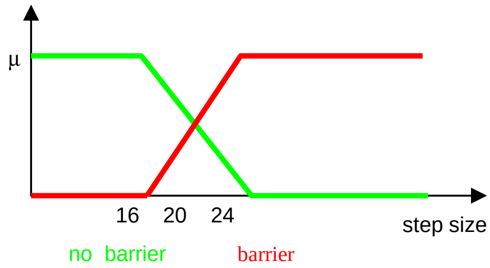

Figure 6: Individualisation of barriers

This ensures that the algorithm can also select indivdualised routes for users with more than one specific handicap. Here a specific barrier can be applied either to the one or the other handicap or it applies to both handicaps what increases the grade of the barrier furthermore. Using fuzzy logic this can also be considered. Simple rules are used to combine the handicaps. Such rules can look like this:

IF handicap_1 AND handicap_2 THEN barrier (1)
IF handicap_1 OR handicap_2 THEN barrier (2)

But the AND operator and the OR operator respectively can not be used when combining membership values for the individualisation. A way to achieve this is using parametric operators. Those operators are adjusted to work between the functionality of the AND and the OR operator. As seen in figure 7 this adjustment has to be done in an offline phase.

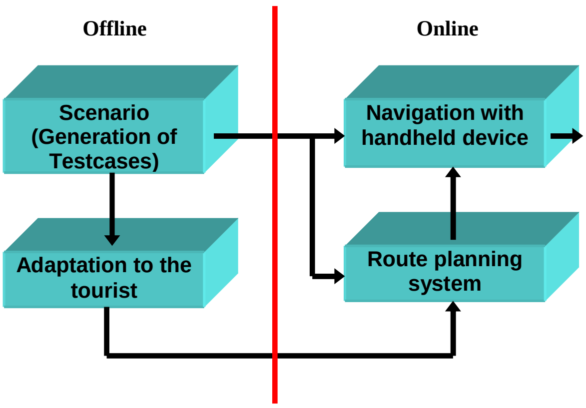

Figure 7: Determination of personalised barriers

Validation and tests

The system has lately been reviewed by a group of blind and seeing impaired persons. This validation process was run in collaboration with the BSVT (Blinden- und Sehbehindertenverband Thüringen e.V. – the association for visual impaired and blind people in

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Thuringia/Germany). A seeing impaired accessible guesthouse was the starting point for a hiking route. After a short introduction to the handling of the system the test persons were guided by the handheld system along this route. Before they reached crossings or other significant landmarks the system gave according instructions. When a user left the route the system directed him back to the correct route. The current position of each user was transmitted to the main server for monitoring the test. After the test users returned they were asked about their experiences while using the system.

Those tests have shown a high level of acceptance but gave also some further hints to improve the usability. The users experienced the system as a good way to aid their available skills.

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. But as a security level of 100% can never be given, the system is designed as secure as possible. The handheld device is able to work without a connection to the server. The server itself is build up redundant, so a second server is always running in hot-standby-mode. If the first server crashes, the second server can take up its work immediately. To ensure the possibility to send out help in any state of emergency, there is always a human operator in the control centre. He has access to the last known position of the user, the battery status of the handheld device and – if necessary – the observed medical value of the user. The system uses information about dead spots in the GPRS or UMTS network to predict when the user will be connected to the network again. If he does not reconnect within a given time after that calculated point in time, help will be send out.

In most cases it will not be possible to remove every barrier in an area to establish the best possible access for any kind of impaired persons. While someone who is seeing impaired needs some structured underground or guidance kerbstones, a walking impaired person prefers an underground as flat as possible, without any heightening. Therefore possible barriers are categorised and stored in the database of the system, so they can be avoided instead of removed. This fact is interesting for financial concerns in a tourist region that wants to offer accessible attractions. In Germany live approximately 6,7 million people with a severe disability. 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 dependent to a wheelchair. All numbers are more or less estimations, because just those people who get national or private support payments can be registered by statistics. [1]

As one can see by this numbers there is a large user group that mostly is not taken notice of. If investors keep that in mind it is possible to get an even bigger source of financial gains in the future.

While a system that is capable to fulfil the needs of handicapped persons was described the main goal is to create a system that can be used by *everyone*. The proposed system can also be used by every other person without noticing the adjustments made for the special needs of handicapped persons. Following this assumption is a big step towards fully integrating impaired persons into daily life.

It is less likely that any assistance system will be accepted by all impaired people but it will help those who are willing to expand their degree of mobility. It is supposable that some people who would not use tourist offers without an other helping person might feel able to accept the TAS system as an alternative to this second person. But also the helping person itself could take advantage of a system like the proposed.

Conclusions

By now the system mainly considers the needs mainly for seeing impaired persons but adjustments for hearing as well as walking impaired people are currently developed. The team is working with the according associations for walking and hearing impaired persons. Contacts to leading manufactures of electric and hand driven wheelchairs are also established.

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