Evaluating a location sensitive multimedia museum guide: Results from a field trial

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INTRODUCTION

Nowadays audioguides are used in several museums around the world. Audioguides offer additional audio information about the exhibition and are usually unable to get the current location automatically. To access an audio file the visitor has to type in an ex-hibit number manually. More recent systems are location sensitive and can present multimedia content such as video, photos or animations.

The authors evaluated a prototype of a multimedial and location sensitive museum guide. The prototype has been evaluated mainly towards usability and media consump-tion within a field trial. This paper gives a short overview of the system and shows the findings from the field trial. Furthermore we visualize the logged user positions within a map.

RELATED WORK

The Museum Tate Modern in London uses a location sensitive multimedia museum. Within the evaluation [2] they mainly evaluated the content use. They found out that audio is the best media choice in most cases as the users can view the object and listen to the audio file simultaneously, while text based content was found to be inappropriate in most cases. In contrast Hsi [3] evaluated the Electronic Guidebook Museum guide at the Exploratorium in San Francisco. He found out that users don't have a strong prefer-ence for a special type of content.

Currently location sensitive museum guides are very rarely used and evaluated. How-ever there are some outdoor tour guides.

Modsching et. al. [4] analysed the spatial behaviour of tourists in the city of Görlitz us-ing GPS trackers. Larson, Bradlow and Fader [5] analysed the paths of shoppers is a supermarket using RFID tags attached to their shopping carts.

MUSEUM GUIDE

The museum guide is PDA (Personal Digital Assistant) based and uses a client-server architecture. The server runs webservices for localization, logging and content genera-tion. For communication between the thin-clients (PDAs) a wireless LAN is used For the field trial four HP iPAQ hx2400 PDAs with Windows Mobile OS, four Netgear WG102 and one Lancom L-54wireless Access Points were used.

Localization

For localization of the PDA WLAN localization algorithms are used (see [1] for more details). For reference measurements of the signal strength of the access points need to be stored in a database. To get the current position, the PDA sends the actual received signal strengths from the access points to the server. The position is calculated from the server and send back to the PDA with the corresponding content. The accuracy of the localization is about 2-3m.

User Interface

As mentioned before the museum guide is PDA based. The location is calculated con-stantly. The user than has to select one of the exhibits in the corresponding area. If an exhibit is selected the user can choose from additional information with different topics. The users can operate the PDA with the stylus or with his/her fingers.

FIELD TRIAL

Test Bed

The field trial has been performed at museum „Strom und Leben" in Recklinghausen. The museum has an exhibition space of approximately 1000m2 spread over two floors. For the field trial we only used the lower floor.

As there was no existing WLAN infrastructure in the museum we installed five access points. Four access points were placed in the four corners, one in the middle. All access points were mounted in approx. 3m height. The four access points in the corners did not have network access, they were only used for localization. Only the access point in the middle was connected to the server. This has proofed to be adequate to ensure sufficient network coverage within the museum for data communication.

Evaluation Methods

For evaluation we used a two-page questionnaire and a logging function. Museum visi-tors were randomly asked if they would like to participate in the field trial. The ques-tionnaire was given to the visitors after they returned the museum guide. Through the logging function every user action was logged in a database. Additionally the current user position was logged every second to get a profile of movement.

In total 136 persons participated in the field trial. About 25% of them fell in each of the age groups

of less than 25 years, 26-40 years and 41-55 years. About 23% were be-tween 56-70 years and the remaining 2% above 71 years old. 60% of the participants were male, 40% were female.

FINDINGS

Audio Content

Within the field trial the users were offered seven different audio files associated to dif-ferent exhibits. Based on the log data we calculated the average time the window was open. After the window was opened the audio file starts playing automatically. Within the window opening time the user can stop and restart the audio file, so that an audio file may be played more than once.

Figure 1 shows the duration of the audio files on the abscissa and the ratio between window ope-ning time and the duration of the audio file on the ordinate axis. It can be seen that audiofiles with a duration longer than 83 seconds are not listened to com-pletely. The window opening time is less than the duration of the audiofile if the audiofile is longer than 83s.

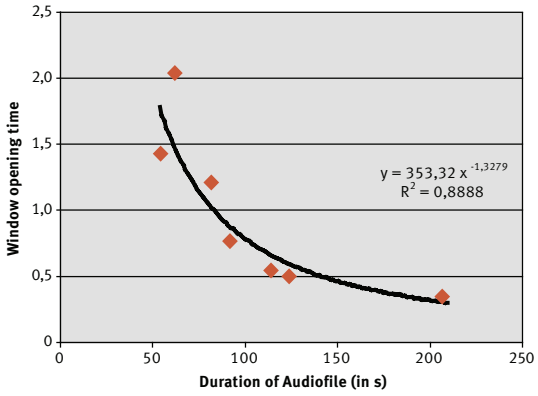

Figure 1: Window opening time against duration of audio file

Text Content

We also investigated the user behaviour regarding the text length. We logged the time the text win-dow was open. We than calculated the quotient between the window open-ing time and the text length. The text length is described in a number of characters. However, if the text length would be described through number of words the finding would not differ. Figure 2 shows the quotient between window opening time and text length on the ordinate axis and the text length on the axis of abscissae. As we see the linear regression func-tion has a negative slope. This means that with rising text length the quotient goes down. A small quotient means that the time the user spends to read one character is small. This can also mean that the text is not read completely because it can be assumed that the reading speed not differs depending on text length.

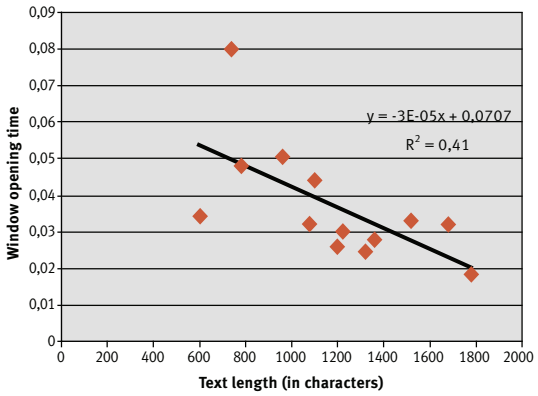

Figure 2: Window opening time against text length

Menu Position

When the user selects an exhibit a menu with several entries opens. From that menu the user can select different content items. The menus contain between two and seven items. The first five items are displayed on the first screen, if there are more than five menu items the user needs to scroll to select item number six or seven. We found out that, depending on the position in menu, the different menu items are clicked with a different frequency. Figure 3 shows the menu position on the vertical axis and the num-ber of clicks on the horizontal axis. The bars for menu position six and seven are col-oured red which means that the cannot be reached without scrolling.

Items in menu position one are clicked most often. It can be seen that there is a trend that the click rate goes down with rising position number. However the last item shown on the display breaks the trend. This can be seen at position number five and seven.

Based on that findings we can state that users obviously more often click on the top and on the bottom items on the display than on the others.

Other Findings

We also found out that about 22% of the visitors who answered the question “What do you think should be improved” said that the visualization

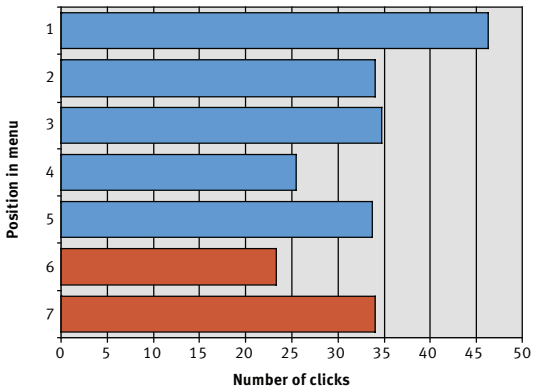

Figure 3: Number of clicks against menu position

of the content should be im-proved. It can be assumed that this goes back to the relatively low resolution of the PDA display. Especially when showing still images are viewed a good display with an high display resolution is needed to display details. Another 21% answered that the would like more audio content substituting texts. However we couldn't find any evidence in log data that audio content had a higher click rate than text content.

Fifty percent of the visitors who answered the question "What did you like most" said that the museum guide was a meaningful extension to the existing information sources in the museum. This finding supports the effort implementing interactive museum guides. Another 25,6 % answered that they liked the audio content.
Within the group of non PDA owners 28% had handling problems while only 21% of the PDA owners had. Because of this it can be assumed that the device "PDA" is un-usual for a couple of people. Older visitors tend to have more handling problems. This can be explained with the lower affinity for computers and mobile devices. For future research we need to simplify the handling of the museum guide.

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VISUALIZATION OF USER POSITIONS

During the field trial the user positions were logged once a second. Based on this data we developed an approach to visualize the user positions and movements. This visuali-zation shows which areas are most interesting.

All positions logged in the database are described by x and y coordinates referring to the lower left corner of the museum map. We produced a grid with a dot pitch of approx. 1,5m. We then counted the number of position log records within a quadrate with an edge length of approx. 1,5m for each grid point on the map. The output is a table with the position coordinates and the frequency of logged positions within the quadrate around the grid point. This means that to each grid point a corresponding frequency can be relocated.

In the next step we used the point grid to produce a triangle grid using Delaunay trian-gulation. Based on that triangle grid we visualized the frequencies of the grid points using different colours (see Figure 4). Between adjacent points we used linear interpola-tion for colour allocation. The result is shown in Figure 4.

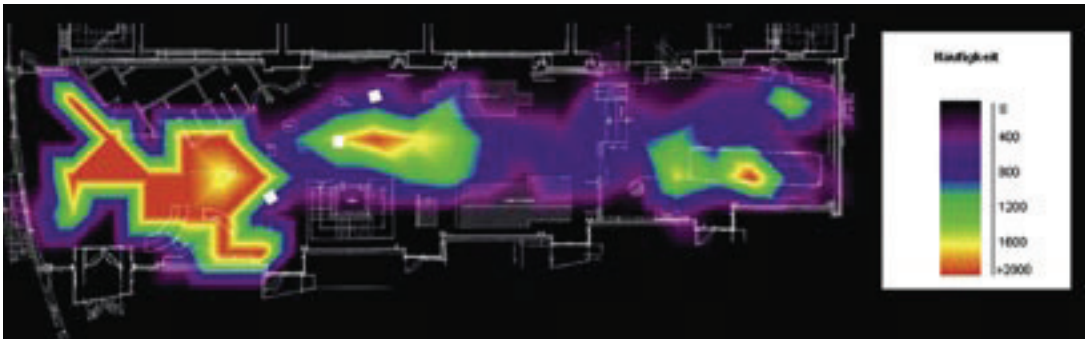

Figure 4: Visualization of User Positions in Museum

All deep red areas have a frequency of 2000 or more, the green areas have about 1400, the blue areas about 800, the purple areas about 400 and the black areas zero. This means that the visitors stayed relatively long within the red, yellow and green areas while the didn't stay too long within the blue and purple areas. In the middle of the pic-ture you can see that the visitors obviously walked along the blue path to the right but didn't stay for a longer time in front of the object on the lower end of the map. However they decided not to walk directly down the three stairs to the next area on the right side. One question for the museum management could be why they walked along this object without stopping there for a longer time. The red spots on the maps mark places where users stayed for a longer period of time.

CONCLUSION

The results of the field trial shows that user acceptance is not generally given. If the content isn't designed properly the users will not be satisfied using the museum guide. Although about a quarter finds that audio content is what they liked most, the results show that audio content should only be used with an appropriate file duration as users tend to cancel the playback if the files are too long. The same observation could be made with text files which were generally not found to be appropriate.

The approach to visualize logged position data is a very useful feature for the museum management. They can see where their visitors stay and how they move. With the re-sulting figure the most visited as well as the less visited objects can be identified. Apart from monitoring the visitors by humans there is no other chance to achieve these infor-mation. Using the museum guide no extra effort needs to be taken as the positions are logged automatically.

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