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The number of multimedia and hypermedia applications in museums is rapidly increasing. Most applications are point-of-information systems presenting additional information on artefacts which are shown in the museum or offering background knowledge on subjects covered by the museum. Publications dealing with such applications are often bare descriptions of contents, technical realisations or user interfaces. There are rather few studies dealing with use and acceptance of such systems by visitors.

In order to decide whether hypermedia applications should be installed museums have to regard costs and benefits: does the rather expensive development of a special application pay in the sense of making the museum more attractive to visitors? Attractiveness, in turn, is the question of usability and acceptance of the application. Therefore evaluation studies which have to deal with ergonomical, didactical, and psychological questions are necessary.

1 Evaluation of POI Systems

Evaluation of computer applications normally starts from the tasks of the users. In POI Systems there is no such given task. Goals and intentions of the users are made up by themselves. Therefore evaluation of POI systems has to concentrate on the questions of what users really do with the system and how they assess it. Methods which are to be used for this purpose must not be expensive in order to provide a reasonable relation between costs for evaluation and benefits for POI applications in the museum.

Subjective methods like questionnaires and interviews are important, because acceptance of the system is a crucial factor. Both questionnaires and interviews can be used to find out the users' assessment of usability, information contents, and design of the system. While questionnaires need rather no personnel for distribution and few for evaluation, interviews require a higher amount of personnel. Thus interviews are often too expensive. On the other hand, questionnaires which are filled in without supervision are not fully reliable.

Objective methods like observations and logfile recordings are best for studying the users' behaviour. However, observations usually require additional personnel and thus are too expensive. Logfile recording requires no additional work. If format and content of logfile records are designed in such a way that evaluation can be done automatically or half automatically, this methods offers a very good relation between the work which has to be invested and the answers which can be obtained.

Other methods of evaluation like guide-oriented judgements by experts or experimental methods are either not appropriate or too expensive. Therefore evaluation of POI systems in museums should mainly rely on logfile recording in combination with questionnaires. Additional observation may be useful. At the German Salt Museum we tried to find out how POI systems can be evaluated with minimized efforts.

2.2 Salt. A hypermedia presentation of the German Salt Museum

This application provides information about salt minerals (origin, formation, structure, appearance, occurrences etc.). It is divided in 3 parts each of which is subdivided in 3 chapters. Each chapter contains between 2 and 48 pages with a total of 107. Each page contains a text on the right which is illustrated by a photograph, a diagram, or an animation on the left (Fig. 1).

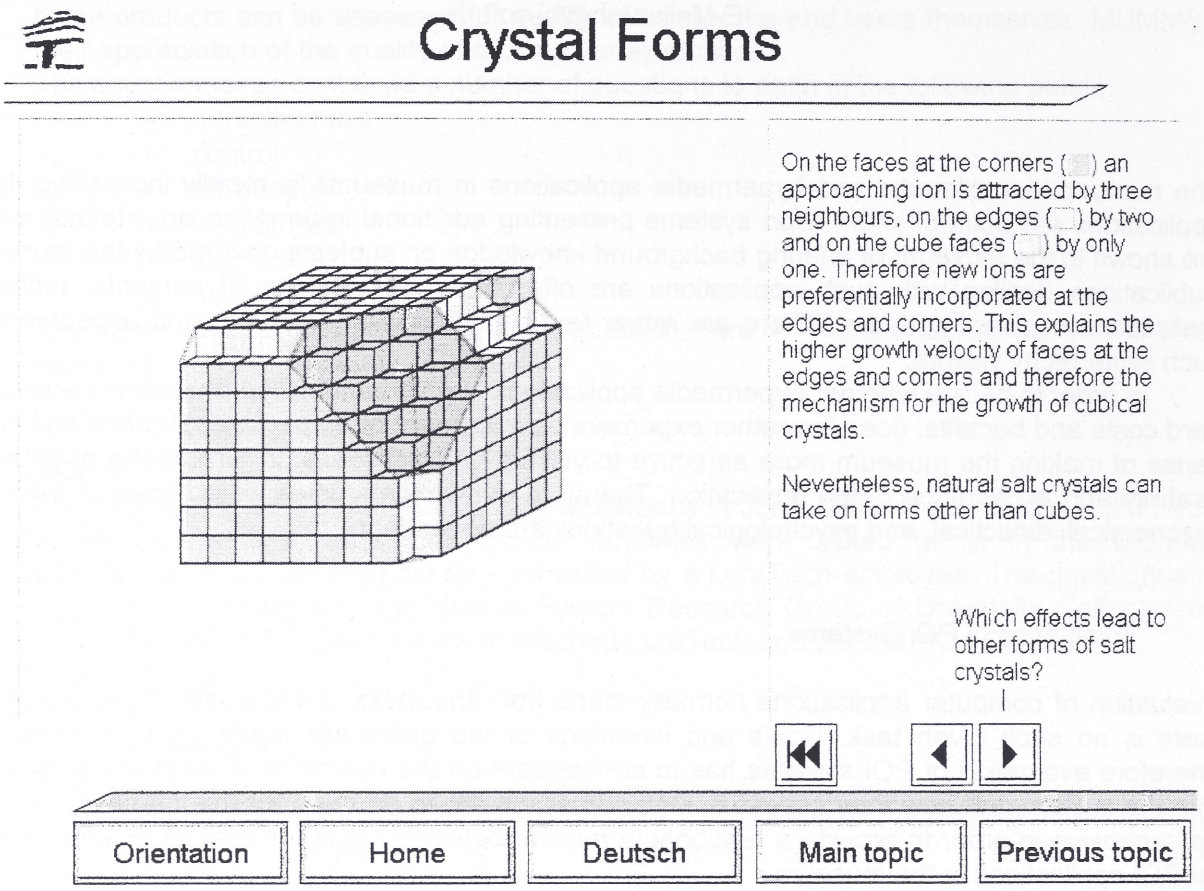


Fig. 1. Screen page of application "Salt."

Selection of chapters is done hierarchically in two steps. Pages can be displayed in sequential order within chapters or by following one of about 65 hyperlinks. Standard controls at the lower part of the screen allow to restart the system, to display a map of contents, to select between German and English language and to go one step up or one step back. The application is controlled by a trackball. It is designed in such a way that a touchscreen could be used either.

2.1 Lüneburg - a large city around 1600

This application provides information about the development of the city, about economical, social, and cultural life within the city, and about remarkable buildings and places based on a map from 1574. There are three different views of the map (overview, full view, zoom view for details). 35 pages of information about the city as a whole belong to the overview, 73 pages of information about buildings and places to the zoom view. Each page contains the map or a zoomed part of it on the left and a text field on the right. (Fig. 2)

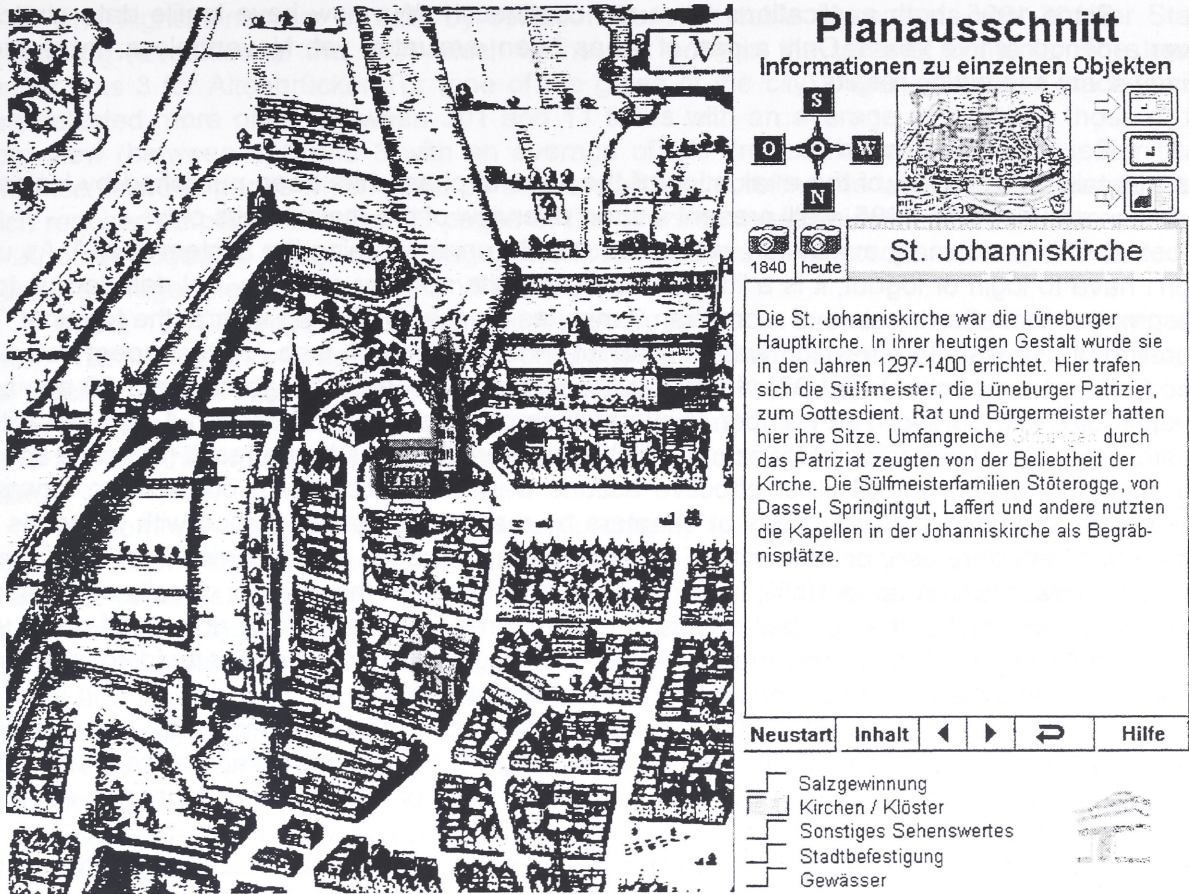


Fig. 2. Screen page of application "Lüneburg" in zoom view.

All pages can be called up by selection from a hierarchical table of contents. It is possible to change between pages by buttons following sequential order (next / previous) or by hotwords (hypertext links). There are about 280 of such hyperlinks plus about 80 hotwords which display additional information in popup boxes. In zoom view objects on the map can be clicked upon in order to display the text belonging to an object. Many pages contain buttons for the display of pictures (about 50), and some of the pictures carry buttons for tracks of sound like church bells or organs (about 10). The application is controlled by a trackball.

3 Evaluation of the applications in the German Salt Museum

3.1 Proceeding

Both applications have been developed by evolutionary prototyping in interdisciplinary co-operation between the Museum's staff, computer scientists, and external specialists. Prototypes have been presented to experts from different museums and tested in public use in the German Salt Museum. By informal observation and by discussions with experts and visitors some problems in interaction and presentation could be solved.

In a second phase in 1994 both systems ran without supervision in the exhibitions. Every action of the users was recorded in a logfile. Each logfile entry consisted of five items: the time of the event (in seconds since midnight), the nature of the event (e.g., click, double click, holding button down for a while), the target of the event (e.g., button, hotword, photograph), the page displayed when the event occurred, and the page displayed after the event. Logfiles are plain ASCII text and can easily be loaded into a database for evaluation. A preliminary evaluation of these logfiles lead to some minor changes of the user interfaces of both applications.

Since 1995, both applications have run continuously. We now have logfile data stretching over a period of five years. Only a part of it has been evaluated yet. Nevertheless, there are already some interesting results.

3.2 Results of the second phase

As a detailed discussion of the evaluation of the second phase has been published by Heinecke, Bumann and Kerstan, 1995, we'll present a short overview of the main results only.

In this preliminary evaluation we had about 480 persons using the system "Salt.". As users don't have to login or logout, it is a little difficult to get the number of users, but data led us to the assumption that after a pause of more than 2 minutes there was another user at the terminal. Total duration of use was 34.5 h which was only about 11% of operation time. Visitors spent between 0 sec (isolated user action) and 37 minutes at the terminal with an average of 4 min 20 sec and a median of 2 min 36 sec. The number of interactions per user ranged between 1 and 904 with an average of 57 and a median of 27 actions. 65% of user interactions had a result (effective actions), 35% had none (errors). 45 % of effective actions were navigations with buttons like forward or backward, another 17 % selections of chapters by menu buttons. Navigation with hotwords took only 1 % of effective user actions in total. Nevertheless, on pages which carried hotwords, navigation with hotwords was up to 10 %. In each of the nine chapters the number of calls of the second page was about half of the number of calls of the first one. This means only about half of the users which had stepped through the menus to the first page of a chapter continued to stay in this chapter by using the forward button leading to the second page.

For application "Lüneburg", the duration of use per visitor was longer. Also, the duration of stay on a page was considerably longer with an average of 17 seconds compared to 7 seconds for application "Salt.". The differences in total number of calls of a page were higher in application "Lüneburg" than in application "Salt.".

Although use of both systems seemed rather poor to us, questionnaires showed very good user ratings both for usability and content.

3.3 Logfile data of application "Lüneburg"

So far, we have evaluated logfile data of application "Lüneburg" of the year 1996. In 1996 total operation time was 2,109 hours. The system was in use for 296 hours which is 14% of operation time. We had about 3,850 users. Thus the average time a visitor spent at the system was about 4 ½ minutes. There was a total of 121,700 recorded user actions which results in an average of about 32 actions per user.

As 49,704 persons visited the German Salt Museum in 1996 only 7.7% of the visitors used the system. At a first glance this seems rather low. Nevertheless there are two main reasons for this ratio. On the one hand, the German Salt Museum didn't want computer terminals to dominate the exhibition. Computer applications were regarded as an additional source of information only. Thus the screen of application "Lüneburg" is situated in an inconspicuous desk beneath the original map. On the other hand, 60% of the visitors of the German Salt Museum come in groups. Most of these groups participate in a guided tour through the exhibition and don't have enough time to use computer applications. Comparison between user counts and visitor counts shows that the percentage of users rises with the percentage of single visitors (up to 16.1%).

Navigation was done mainly by use of the six buttons "Home", "Contents", "Previous Page", "Next Page", "Back", and "Help" (from left to right in Fig. 2). About 28,000 times one of these buttons was pushed. 9,100 times visitors clicked at an object of the map. 7,600 times a page was addressed by selection from the table of contents. Only 1,400 times users followed a link between pages by clicking at a hotword within the text although there are 280 hotwords on 108 pages.

The total number of calls of different pages ranged between 1,379 for Saline (Salt Works) and 53 for Bürgerhäuser (Houses of Citizens). Pages of the overview were called more often (between 1,283 and 209 times with an average of 459) than pages of the zoom view (between 1,379 and 53 with an average of 295). As the system comes up in overview after each restart by the "Home" button, this shows that many users don't change from overview to zoom view.

The highest number of calls by selection from the table of contents was 301 for Stadtentwicklung (Evolution of the City) which is the first entry in the table of contents. The lowest number was 3 for Altenbrücker Tor (one of the gates of the city). Again, pages of the overview were selected more often (between 301 and 11 times with an average of 72) than those of the zoom view (between 188 and 3 with an average of 29). In both views there was a significant difference between pages which could be selected without scrolling the table of contents and those which required scrolling. The first 15 pages of the overview were selected 122 times on average, the 20 other pages 35 times on average. The first 15 pages of the zoom view were selected 74 times on average, the 56 other pages 16 times on average.

About 12,700 times users changed between pages in overview by use of a navigation button. This means an average of 362 hits per page by the buttons "Previous Page", "Next Page", and "Back". The first page in sequential order had 982 hits. Numbers of hits decrease continuously to a level between 226 and 194 for pages 24 to 34. The last page 35 was hit 320 times obviously due to the fact that it can be reached from the table of contents by clicking the "Previous Page" button.

In zoom view users changed between pages by use of a navigation button about 7,950 times. This means an average of 112 hits per page. Again, the first page in sequential order after the table of contents of the zoom view had the most hits (345). Numbers of hits decrease more or less continuously to a level between 100 and 47 for pages 20 to 68. Like in overview, the last 3 pages were hit more often (up to 520 times for the last page).

8,900 times users clicked an object of the plan in zoom view. Thus each of the pages belonging to objects like houses, places and so on was selected 151 times on average. Selections range between 512 and 5. Roughly, the larger an object appears in the plan the more often it was selected.

The toggle buttons which colour different groups of objects in the plan (lower right side in Fig. 2) were used about 12,700 times. Numbers of use are in order of arrangement on the screen from top to bottom and range between 3,650 for Salzgewinnung (Production of Salt) and 1,424 for Gewässer (Rivers).

About 1,060 times the "Help" button was clicked. 580 users left the static help system immediately from its first page, 240 from the second page. The other pages of the help system were called about 100 times each. Except of the first page all pages of the help system had an average duration of stay remarkably shorter than the time needed to read the information on the page.

4 Analysis of Results

4.1 Basic conclusions

The more intensive use of pages of the overview suggests that quite often users don't get into zoom view. The graphical buttons which indicate the current view and allow to change to another one (top right side in Fig. 2) are not obvious enough.

In 1996, the use of hotwords as links between pages was rather low. Perhaps then the concept of links was not as widespread as it is today with the rapidly increasing use of the World Wide Web. Logfile data of 1999 will soon show whether the use of hotwords has increased.

Most interactions which change pages are clicks on the "Next Page" button. Combined with the fact that average duration of stay on a page is in most cases shorter than the time to read all of the information this proceeding reflects our handling of unknown books. We turn pages rather quickly to check if there is anything interesting.

Selection of pages from the table of contents is remarkably lesser if the table has to be scrolled. Users who are not accustomed to standard scroll bars may have problems to see the whole table of contents.

A detailed help system which explains all means of interaction is wasted effort. Only about ¼ of users press the help button. ¾ of those who do only read the basic instructions.

Colouring groups of objects in the plan and clicking at coloured objects is used rather frequently. In zoom view changes between pages are more often done by clicking objects than by clicking navigation buttons.

4.2 Re-design of application "Lüneburg"

The German Salt Museum currently rearranges some of its exhibitions. The application "Lüneburg" shall be presented in a more central place and shall be available on CD at the museum's shop. This is the reason for a re-design which shall address the findings from our evaluation, too.

Besides a clearer arrangement of the display we plan some changes in the elements of interaction. Figure 3 shows the prototype of the new version with the same page as in Fig. 2. All buttons are arranged in an interaction bar at the bottom. The graphical buttons for the change between views shall be replaced by a "View" button (lower left side). The toggle buttons for colouring the objects are replaced by a "Marking" button. The buttons for pictures (two buttons in Fig. 2 above the text) are replaced by a single "Picture" button. The buttons for sounds which become available in the old version only if a picture is displayed are also replaced by a single "Sound" button. Pressing one of these four buttons offers a menu each.

We hope that the new "View" button will lead to a more frequent selection of the zoom view. The navigation buttons are a bit more unobtrusive than in the old version in order to put more emphasis on other means of interaction. The help system has been omitted as the information which was given on the pages that were actually read in fact was necessary to know in order to get the help, too. In the table of contents we shall use scroll buttons similar to the navigation buttons instead of scroll bars.

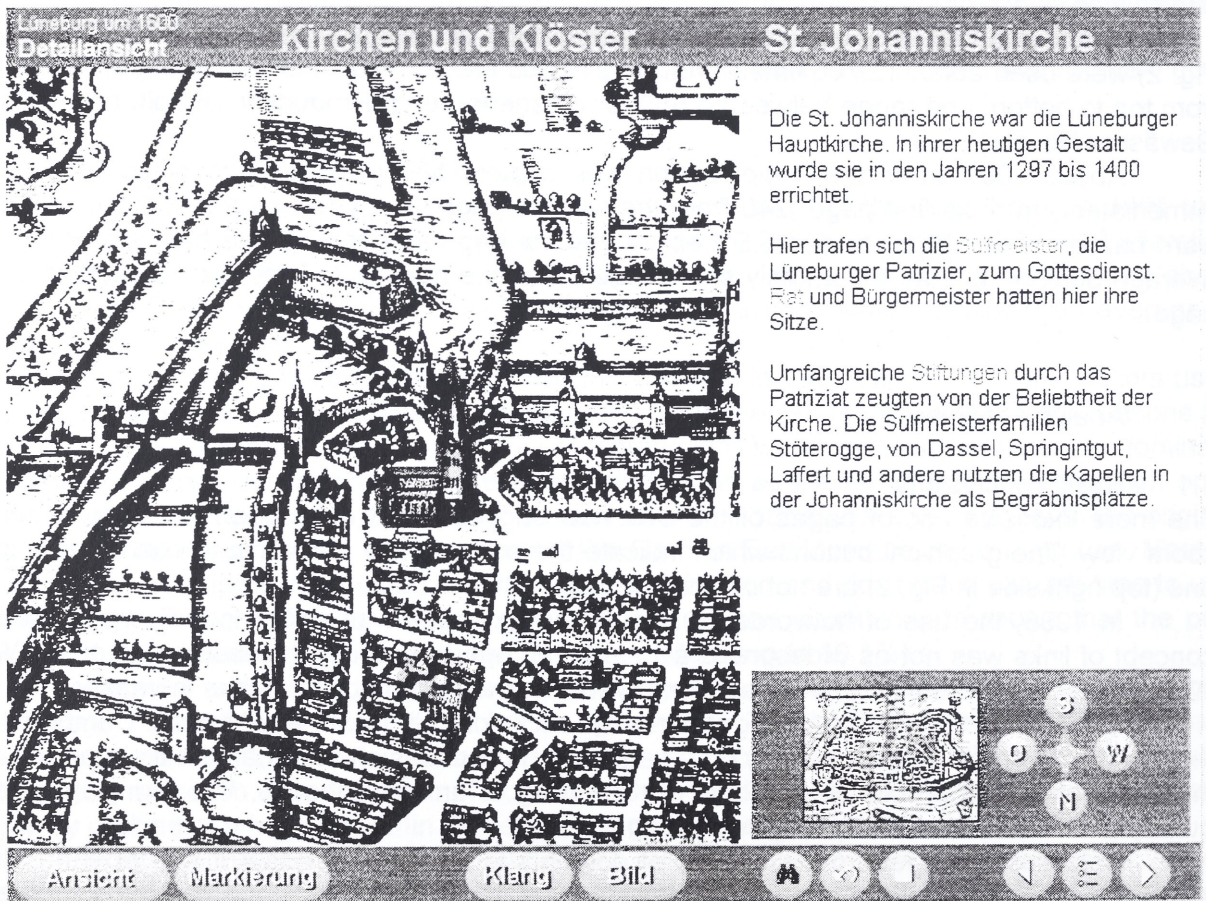


Fig. 3: Application "Lüneburg" in zoom view, prototype of new version

Logfile recording is a valuable means for evaluation of POI systems in museums, provided that logfiles can be analysed easily. This can be achieved by using a standard database which supports detailed queries. Analysis of logfiles can give hints for ergonomical improvements of the user interface. Logfiles are also capable of showing user preferences with respect to media and / or contents.

Questionnaires and observations can be used additionally in order to study different groups of users. For future studies we shall make use of existing control cameras in order to correlate logfile recordings to different types of users with respect to age, sex, and single visitor vs. group of visitors.

6 Bibliography

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