Der Einfluss von mobilen Informationssystemen auf das Verhalten von Touristen: Resultate einer Feldstudie

The impact of mobile information systems on the behaviour of tourists: Results from a field study

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Zusammenfassung:
Mobile Informationssysteme sollen einem Touristen helfen eine Stadt individuell gemäß seinen Interessen zu erleben indem sie z.B. Sehenswürdigkeiten abseits der touristischen „Trampelpfade" finden. Aus der Perspektive des Destination Management soll eine breitere Verteilung von Touristen in der Stadt erreicht werden um so zu einem längeren Aufenthalt zu motivieren. Dabei ergänzen mobile Informationssysteme traditionelle Informationsquellen wie gedruckte Karten, Reiseführer oder Beschilderung. Die wichtigste Frage ist: „Werden mobile Informationssysteme von normalen Touristen angenommen?". Falls ja stellt sich die Frage: „Welchen Einfluss haben mobile Informationssysteme auf den Besuch eines Touristen?" Diese Fragen wurden quantitativ und empirisch in einem Feldversuch im August in Görlitz untersucht. Dazu wurden an eine Kontrollgruppe von Touristen GPS Empfänger verteilt. Zwei andere Gruppen erhielten MDAs mit zwei unterschiedlichen mobilen Informationssystemen. Alle drei Gruppen erkundeten alleine die Stadt. Die erste mobile Applikation stellt die Attraktionen in einer Karte dar und der Tourist kann multi-mediale Informationen zu jeder Attraktion abrufen, während die zweite Applikation die allgemeinen Interessen des Touristen erfasst, die Attraktionen bewertet, eine Tour berechnet, die Ausführung derselben durch Navigationsanweisung unterstützt und den Tourplan falls notwendig an das aktuelle Verhalten anpasst. Zu allen Gruppen wurden einige Basisdaten, z.B. zur Vertrautheit mit einem Computer, die Positionen während der Stadterkundung und die Zufriedenheit nach Abschluss der Tour erfasst. Zusätzlich wurden in den beiden Gruppen mit Applikationen die Interaktionen, z.B. Klicks, gespeichert. Diese Daten wurden analysiert um den Einfluss von mobilen Informationssystemen auf das Verhalten von Touristen im Rahmen einer Stadterkundung zu bestimmen.

Abstract:
Mobile tourist guides shall help tourists to discover sights off the beaten tracks and therewith spread them over the destination more equally. Mobile information systems complement more traditional means of information provision, e.g. printed maps, guide booklets or simply signage at the destination. The most important question is: "How are mobile information systems accepted by ordinary tourists??" In case of a yes the next question is: "How does an information system impacts the visit of the tourists?" These questions were studied in a field study with real tourists in the city of Görlitz in August. A control group received a GPS logger whereas the other two groups received mobile devices with two different mobile information systems. All three groups explored the city on their own. The first mobile application displays the current location of the tourist and attractions in a map. The tourist can request multi-media information about each attraction. The second application elicits the generic preferences of the tourist, ranks the attractions, computes a tour, supports the execution via audio navigation instructions and adapts the tour plan as necessary. For each group some basic data was collected before the tour, e.g. computer literacy. During the tour the positions and interactions were logged and after the tour a questionnaire gathered additional data. The spatial behaviour and interaction logs was analysed to determine the impact of a mobile information system on the behaviour of tourists during a city tour.

Introduction

The today's ongoing progress in mobile computing power and the increasing accuracy of positioning technology like GPS and in future GALILEO makes a mobile digital tour guide a more and more realistic scenario for tourism in the near future. Looking back on years of research on mobile recommendation, guidance and context-aware information presentation, a lot of promising concepts for very different kind of guides were developed. Thereby the guides generally can be classified into push- and pull based services and very often deliver information in a very sophisticated way (e.g. audio, video, morphing pictures of different decades, 3D reconstructions etc.) comparing to traditional guide books. Additionally mobile intelligence has the advantage to calculate individual tour plans and with the help of GPS navigating the tourists to the single spots of the tour. The hope is that individual tourists will use a digital tour guide and therewith enjoy a destination to its full potential. A digital tour guide can increase awareness for other sights which might motivate a tourist to extend the stay. This is of tremendous economic importance for a destination management.

Unfortunately most of the currently developed digital guides are still concepts or prototypes and rarely applied in field trials with valid tourists. That's why the impact of such systems on the spatial behaviour and activities is entirely unknown. For such an effort the software has to be developed to a stable release state with a graphical user interface (GUI) accessible to a common tourist. This would increase the likelihood that an ordinary tourist would be able to use the application even without any technical support. This is very challenging because the application has to offer capabilities still very much a topic of research, e.g. mobile recommendation, elicitation of preferences, tour planning, tour adapting as well as it has to be pushed through several development phases (alpha, beta) to a certain level of maturity. The participants of the field trial have to be real tourists who aren't aware of the majority of the sights. Most of them have never used a mobile device like an MDA (Mobile Digital Assistant). To compare the behaviours with and without a digital helper a control group has to be introduced. This group should explore the city in a traditional way e.g. with a flyer or a guidance book. By comparing the spatial movements between the groups the impact of context-aware information on the behaviour becomes visible. Especially the length and duration of tours, the number and types of visited sights, the activities and the satisfaction are important indicators to the power a mobile information system can really have. This paper will analyse these and other factors with data collected during a field trial.

Related work

The following works were influencing the design and development of the applications compared in this work:

- Cyberguide [1] was one of the first mobile tour guides. It works outdoor with GPS and indoor with infrared to determine contextual information like users' position and orientation. Personal preferences are not analyzed to compute a tour plan, but the user can receive information actively about anything which is modelled. Requesting a route to a desired Point of Interest (PoI) is possible too. In addition it provides the option to create a kind of diary about the whole tour.
- The Dynamic Tour Guide (DTG) [5] offers two modes: Planner and Explorer. The Planner elicits the general preferences of a user and selects the sights which are most interesting for the user. A semantic matching algorithm was applied to rank the attractions. The DTG uses a heuristic tour calculation algorithm to calculate a tour fitting to the allocated duration in less than 10 seconds. The user gets to the sights through by an integrated standard navigation package. After reaching a sight the DTG starts automatically with the information presentation (push-based). If a user ignores the tour plan or is to fast or to slow the DTG is able to adapt the plan by adding or removing sights. The Explorer presents the current location of the tourist in a map and the marks the surrounding attractions. It is left to the tourist to select a sight, request multi-media information and to plan the route towards it.
- GUIDE [3] is a mobile tour guide with concepts most related to the DTG Planner. The visitor chooses attractions from various categories. These attractions are then sequenced taking into

account the opening hours, best time to visit and the distance between attractions. The sequence can be modified manually. Navigation is achieved by a map with a list of instructions. Differences to the DTG are the use of cell based positioning instead of GPS and the selection of concrete sights instead of deriving the selection from generic preferences.

Each of the three presented guides is a mobile and context-sensitive system and able to deliver multimedia information to the user. They apply different concepts to guide the tourist to the sights. The DTG Planner uses a standard navigation package including a map, route and audio-navigation instructions. The selection of the sights in the GUIDE project is more active and let the user select what he/she wants to see. For our study we will compare the impact on the behaviour of both approaches.

Field trial design

The main focus of the field trial was to find out how the tourists will accept information systems and how the behaviour of the tourists will change depending on the kind of information they got. Therefore three groups were created – two with a mobile information system and one as a control group supplied with a GPS logger to track the movements and otherwise relying on traditional information sources. For the field trial 30 mobile devices could be allocated for a period of 4 weeks in august 2006. A stand on the most relevant position in the heart of the medieval centre was used to distribute and retract the devices.

In order to cover most areas relevant for the tourist the distribution and retraction model was extended to enable a flexible distribution at various places in the city. A group of students walked through the city and asked tourists whether they wanted to attend the field trial. If a tourist agreed either a MDA-GPS configuration was handed out or a standalone GPS logger. To ensure that the tourist gave back the device, a form with some formal information (e.g. personal id, name, phone number etc.) had to be signed. The tourist also got some documents with additional information like technical advices, a map with possible return places and a questionnaire form. Even the retraction of the devices was decentralized meaning that the devices could be returned either at the stand or at one of twelve evenly distributed retraction points in the city. Those points where either hotels or restaurants because they aren't restricted to the business hours. With this model of retraction the tourists had the flexibility to retract the device whenever and wherever they wanted and helped to increase the willingness of attending the field trial.

Explorer Mode (Pull)

The DTG Explorer is a pull-based information system showing only a map with the actual position to the user. Additionally the map displays all of the sights which are nearby and a constantly updated list of sights which can be found within 100 metres. A click on an item in the list will trigger the information presentation. An additional way of triggering the multimedia presentation is a visit to the sights activity area for than 10 seconds. To stop the presentation the user can either leave the activity area or just click on the map-button to bring the actual map to the front. This mode follows the traditional way of sight seeing where a tourist holds a map in the hands and has to find the sights his/herself.

Planner Mode (Push)

The DTG Planner's core concept is the idea of a personalized tour (5). Therefore the DTG planner elicits generic personal interests and some constraints for the tour like duration, endpoint and some restaurant constraints. It ranks the attractions and calculates an individual personal tour plan. The tourist reaches each sight by navigational instructions in audio generated by a standard navigation system. Additionally the DTG planner displays a map with the route. If the tourist reaches the sight the planner starts the information presentation automatically (push).

Results

All together 397 tourists participated in the field trial. 146 tourists used the Explorer, 133 the Planner and 118 visitors took the GPS logger. The mean and almost the median age of the

attendees for the Planner was 48, for the Explorer 50 and for the loggers 54. Fig. 1 shows the computer literacy of the attendees.

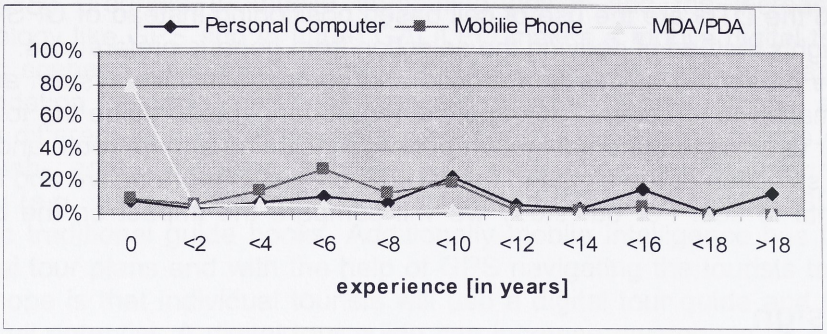

Fig. 1 computer literacy

80% of the tourists participating in the field trial have never used an MDA/PDA before. On the other hand the mean duration of experience with PC's was 10 years. The familiarity of mobile phones is somewhat in the middle. May be a mobile electronic tour guide is an attractive proposition even for older people despite the lack of familiarity, a screen with just 4% of the pixels of a regular monitor, a display with a brightness and contrast not really sufficient on a sunny day, small buttons and especially sliders for scrolling that require a high level of hand-eye coordination to be successful. The logs with screenshots indicate that at least in the beginning many tourists had to click a couple of times with the pointer until they were able to move a slider. Nonetheless they participated, may be for curiosity or because they can envision that a mobile information system meets their needs. The important question now is: "Did the tourist really use the device?"

Duration of use

The duration of usage for all three groups is shown in Fig. 2. The tourists with the Planner and Explorer had used the device for tours with 1 – 1,5 hours. The device was called a Tour Guide and thus was used as such. With navigation enabled guidance system this is enough time to get a tour along the most important sights through mediaeval centre of the city. The Explorer application had a median duration of use of 1.7 hours and therewith slightly longer trips than the Planner group. This group didn't have navigation instructions and had to find the sights themselves.

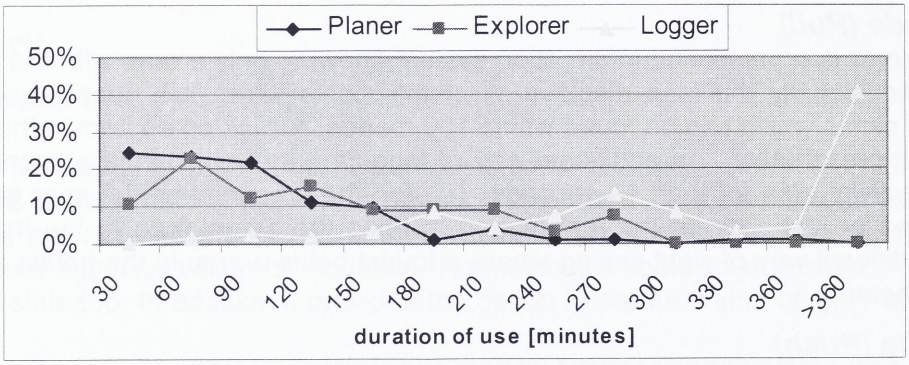

Fig. 2 Distribution of actual tour durations

Comparing this to the group with the GPS logger shows that the duration of use was drastically longer than the ones of the other two groups. The GPS loggers were used 4 hours in median. This group obviously just forgot the logger in their bags. Thus the logger captured data beyond the sightseeing tour and may include segments with other possible activities like eating, shopping, visiting hotel, relaxing (in a park), visiting a museum.

Interactions during the tours

The duration of use of the Explorer and Planner is with ~1.5 hour pretty close to the duration of traditional guided tours. However the question remains if the tourist did really interact with both mobile application or if the mobile device went into a pocket and the tourist complete their tour of

the city on their own. All interactions with the Planner and Explorer were logged. The median number of clicks during certain segments of a tour is shown in Fig. 3.

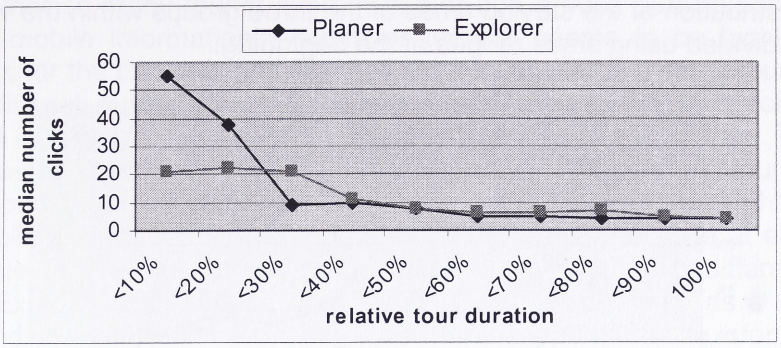

Fig. 3 Median amount of interaction during tour

The distribution of interactions of the relative tour duration shows that there is a lot of interaction at the beginning. This high amount of interactions is in the case of the Explorer due to familiarization with the mobile device, e.g. training hand-eye coordination to use the pointer to click on buttons displayed by the small touch screen as well as the menus and options of the mobile applications. Additionally the tourist using the Planner went through elicitation of preferences and setting the constraints of the tour. A reason for the steep drop during the first quarter of the tour might due to users who gave up using the mobile application or that the automatic triggering of the information presentation had improved during the tour e.g. through better understanding of the navigation instructions. The next remarkable issue which Fig. 3 shows is that there is a stable plateau of interactions in both groups until the device is being returned. This means that most users used the application during their tour and retrieved information to the sights. The users didn't put the devices in a pocket and muted the information presentation or the possibility to get more detailed information. The question which now remains is: "Did this investment of effort paid off through e.g. an enhanced experience?"

Visiting behaviour of sights

This section will compare the amount and duration at the attractions. Since the mobile information systems presented in this study had implemented both the approach of activity areas in Kramer et. al. in [6] to trigger the information presentation, these areas could also be used for the recognition of the visits. A visit was defined as single stay in a hot area longer than 40 seconds. Fig. 4 shows the distribution of the number of sights visited by a tourist.

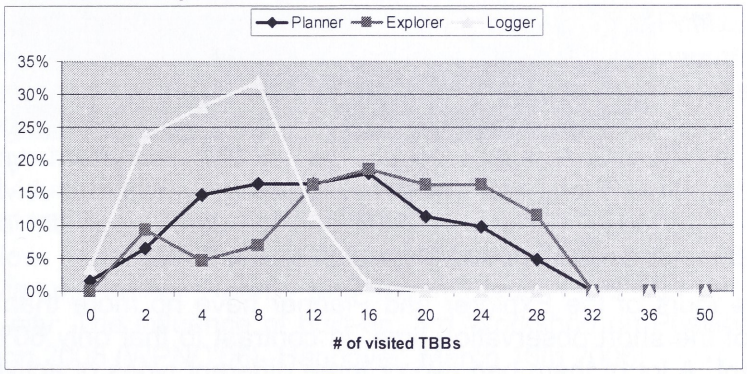

Fig. 4 number of visited sights

A tourist holding a context aware mobile device in his/her hand will see a median number of 14 sights with the Planner and 16 sights with the Explorer. In contrast to that the median number of sights visited by exploring the city traditionally is at median only four. That means a mobile device enables a tourist to see 4 times more attractions in 1.2 hours than another tourist using traditional means of information is able to enjoy in 4 hours. A tourist without a mobile information system walking in the city discovers a median of four attractions and then leaves thinking that he has "seen

it all". From the perspective of destination management a mobile information system makes the destination looks 4 times broader.
Fig. 5 shows the distribution of the staying times of the three groups within the virtual areas. The x-axis is non-linearly divided using small ranges at the beginning.

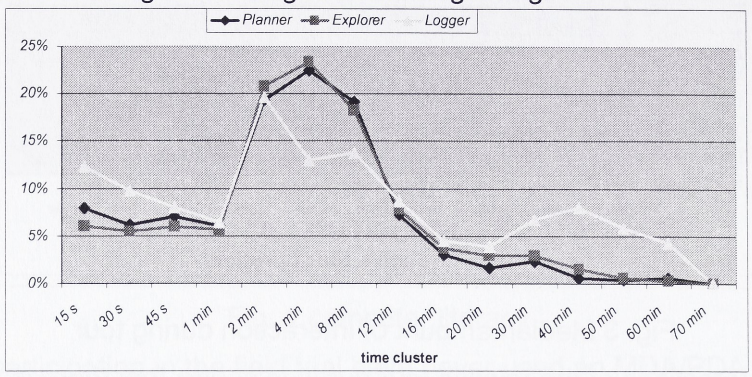

Fig. 5 Distribution of the activity duration

This chart indicates that the tourists using the Explorer and Planner are staying the same amount of time at the sights with a mode at 4 minutes. This is pretty close to the duration of the multi-media presentation. Comparing this peak to the curve of the Logger group visualizes that they have much more users at 15 seconds. Potentially they come along many sights but just don't recognize them. This group has also a mode at 2 minutes for the visit duration which is only the half of the mode of the other two groups which means that even if they discover a sight due to a lack of information they can't enjoy it only half. Finally the curve has another mode at 40 minutes showing that the Logger group has stayed in a hot area for a significantly longer time. That might be due to the fact that the tourists carried the logger 3 times longer than the Planner or Explorer. Therefore the logger captured activities outside of a "City Tour" like shopping, having a meal etc..
The following chart about the number of segments substantiates this claim of more than one segment within the Logger group. A segment was defined as a continuous activity for a period longer than 20 minutes. This activity was identified by the spatial behaviour of the tourist (e.g. walking, stop and go, staying).

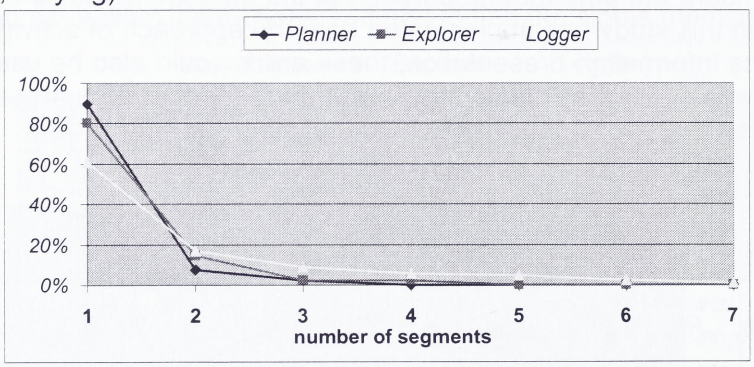

Fig. 6 activity segments in the groups

It is obvious that the tours of the Explorer and Planner have no more than one or at most two segments because of the short observation time. In contrast to that only 60% of the logger tours had only one segment. A lot of them had two or three different types of activities like sightseeing, shopping, eating, museum and so one. That means that people currently utilize the tour guide only for the sightseeing part of their stay taking the name "tour guide" quite literally.
The most helpful mobile guidance system for a tourist would obviously be able to support an entire day or even the whole trip and support therewith more than just the one sightseeing segment. It also should help a tourist to:

- offer multiple tours at several days or parts of day with respect to the already visited sights
- support restaurant visits, shopping opportunities and museum visits
- support a walk-around tour to enjoy the atmosphere with little information

Conclusion

We were amazed that so many tourist even in higher age groups participated in the field study. The concept of a mobile information system for tourism seems to be highly acceptable. The duration of the tours for the Explorer and Planner are very similar and with around 1.5 hours within the pattern of traditional guided tours. Despite the challenge of using a completely unfamiliar mobile device 74% of the tourists kept interacting until the end of the tour. The effort invested measured by the median amount of 92 clicks lead a return in discovering four times more sights than the group of tourists relying on traditional means of information, e.g. sights. Furthermore the tourist using a mobile information system spent twice the amount of time at each sight, which is probably mainly due to the multi-media presentation. The observable differences between the tourists using the Explorer and Planner were insubstantial, which came as a surprise since both applications are fundamentally different. It might be that the type of mobile information system – as long as it is well done – is much less important than to make information accessible to the tourists. From the view point of destination management using a mobile information system enlarges the perception of the breath of sights a destination by a factor of four and makes each sight twice as interesting.

Acknowledgements

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