# Towards Task Oriented Map-based Mobile Guides

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## ABSTRACT
The adaptation of mobile services to context specific parameters provides great potential for developing enhanced and more user friendly systems. In this article we argue that in addition to technical issues (display size, bandwidth, etc.) and user centred factors (demographics, preferences, etc.) especially situational aspects (e.g. location) need to be considered when designing new mobile guides. One major situational parameter is the *task* which the tourist wants to accomplish in using the mobile system. This provides a range of implications for the individual usage process

## Keywords
Tourist guides, mobility, context-awareness, task oriented maps

## 1. INTRODUCTION
Since the emergence of *Location Based Services* (LBS) accompanied by the UMTS hype, much effort has been put into the development of mobile services. Naturally, tourism belongs to the most promising application fields for LBS and various scenarios picture tourists using these. Mobile tour guides have also become one of the most popular context-aware applications as the use of positioning services allow these systems to provide information about the surrounding environment using *location* to filter the relevant information. Some research has been done in developing location based, mobile tourist services - though with different focus, e.g. CRUMPET [28], [31], [32], DEEP MAP [41,42], mToGuide [23] or [26]. Some projects focus on context-awareness e.g. Guide [9], Cyberguide [1] or comMotion [22]. Further mobile tour guides deal with Multi-Modal-interaction like Smartkom [4], others with multi-media design [27]. Handling location is a starting point towards enhanced context aware services, but other parameters have to be taken into account additionally in order to design user friendly guides - in particular for maps [39]. We argue that the *task* the tourist wants to perform needs to be examined in particular, as it represents an important basis for the design of interactive maps for mobile guides.

## 2. TASKS IN MOBILE TOUR GUIDES
In general, tourists will only make use of mobile services, if they provide sufficient support for various tasks to help reaching their goals more easily than without an electronic companion. Obviously, tasks and needs during mobility differ from those in a stationary environment, since the scope for potential tasks is much broader and situations can change more rapidly in a mobile environment. Designing mobile services for tourists should therefore focus on their practical activities and typical tasks. The problem is that tourism encompasses al lot of potential activities, such as sightseeing, shopping, relaxing or visiting friends. Moreover, tourist related tasks are often not determined by an overall goal, but are much more open ended. Mostly they are not highly structured and specific, so that tourists can take advantage of changing environments. It is also necessary to support this flexible nature of tourist plans by mobile tour guides. Most such systems have been designed to support tasks tourists do while there are actually on their trip. But mobile systems need to include enhanced functionality to support the whole tourist life cycle which consists of three major phases: *before trip, on site* and *after trip*. This includes co-visiting aspects during the trip as well as pre- and post-visiting places. Especially when co- and post-visiting are considered by the system new mobile tourist services respect tourism as a social activity. Within this paper we focus on two aspects; first: task and map production, and secondly: task and enhanced functionality of mobile tourist guides.

## 3. MOBILE MAP USE
A range of critical tasks when visiting a foreign place include the use of maps. In the domain of map use some research has been done in fields of cognitive psychology and cultural studies. Meanwhile there is still little understanding of how tourists organize their activities or the problems they face *in situ.* Only few studies have exclusively been donated to tourism or have drawn special implications for the design of these mobile services [6]. This usage centred approach emphasises the decisions tourist make and the information they use to accomplish their tasks. Maps are commonly used to compensate the lack of knowledge in spatial problems, and in most cases they are used for visualization in mobile services [12]. The question is how maps can be adapted to the various tasks tourists usually do. Consequently the potential tasks as well as the communication goal of the map, which has to be generated by the system, will have to be identified.

### 3.1 Task oriented map production
The most obvious and prominent tasks maps are used for are orientation and navigation, but they also commonly serve as a tool for exploring and planning purposes including searching for particular points of interest. [30] distinguishes four general groups of user tasks in a mobile environment, namely locators, proximity, navigation and events. These tasks represent high-level tasks which can be redefined and further subdivided into several subgroups. Further down the hierarchy, low-level tasks, such as panning, zooming or rotating, are used within each task to further adjust visualisation needs by map based interaction.

- Locator tasks answer questions such as “where am I”?
- Proximity tasks are used to find specific facilities nearby.
- An example of a navigation task is routing.
- Event tasks encompass the condition of a specific location (e.g. opening time of a museum) / what is happening when.

According to [30] it is necessary to separate *goals* and *plans* of a user from the *tasks* needed to achieve them. E.g. the navigation from one point to another encompasses several minor tasks, such as following directions or the translation of the displayed location on the map to the real environment. A mapping between goals and tasks will help to find different modes for specific tasks.

**Table 1: A typology of tasks in map-based mobile guides**

| High-level tasks | Subtasks | Communication goal / Purpose |
|---|---|---|
| Locators | own position<br>position of objects<br>position of other persons | orientation, navigation, overview |
| Proximity | objects<br>persons | orientation, navigation, overview |
| Navigation | routing from point A to B<br>predefined Tours<br>personalized tour proposals | navigation, exploring, planning, education |
| Events | time dependent objects (e.g. exhibitions)<br>time critical objects (opening hours of museum)<br>traffic information | planning, exploring, overview |
| Identifier | objects<br>persons | detailed, additional information |
| Themes | activity (social zones), e.g. restaurant, shopping etc. | orientation, exploring |

A common and popular practise in identifying the needs of the aimed user group is task analysis. In most cases the focus is on functional aspects and data modelling. An integration of tasks within the context of activity is missing. Up to now, there are only few results from empirical cartography dealing with systematic analysis of tasks with mobile cartographic media [11], [12].

## 3.2 Towards an ontology of tasks in map-based mobile tour guides

In the domain of spatial information systems [21], [36], [13] ontologies have become an important research area. New approaches deal with the generation of spatial aware information systems from geographical ontologies [40]. Here the work on ontologies for wayfinding [35] and in support for activities in geographic space [19] is of particular interest. This leads to the question of relevant tasks within geographical information systems in general as researched by [2]. Based on these [34] is currently working on geographic task models for geographic information processing. While these work is still quite general, there have also been first attempts to start developing task ontologies in the area of visualization [8] and geo-visualization in general [18]. A recent project is NAVIO [24]. The hypothesis is that user activities can be described formally. This can then be used for specifying mobile services. Therefore the research task is to develop a task ontology to yield context-dependent conceptualizations and activities.

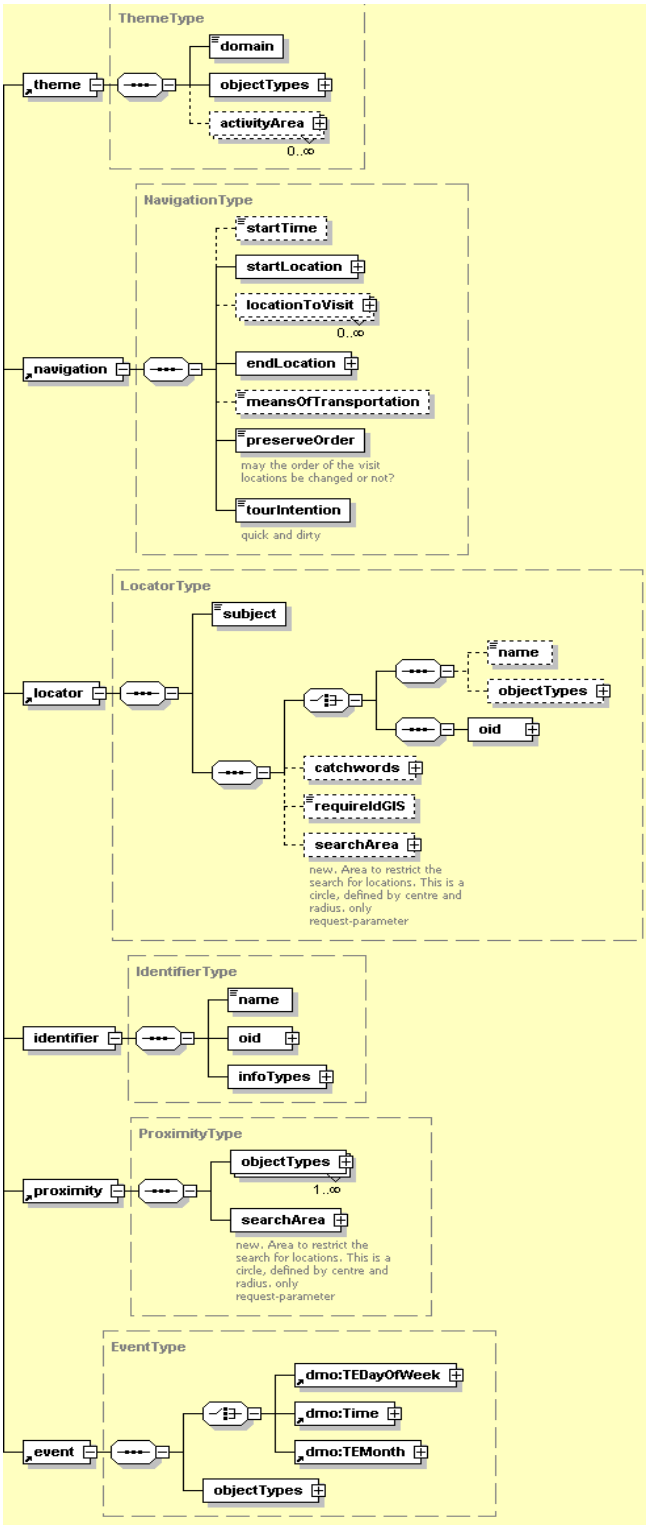


**Figure 1. Extract of XML schema of the "MapTask" model**

All this gives us a foundation for our work on task models for mobile map-based tour guides. Here we are currently working on transforming and enriching the typology presented in Table 1 into an ontology that can be used by system designers and developers

for the development of mobile tour guides. A typical representation is XML. [15] present xml-schema for „multi-modal“ map interaction in mobile guides using the low level tasks identified earlier. Further work is needed to integrate also the higher level tasks in such system ontologies. A first version of how map relevant tasks for mobile tour guides can be modeled is given in figure 1. The following chapters explain this in detail.

### *3.2.1 Themes (Thematic areas)*

One frequent way tourists use maps is to reassure their relative orientation. Often they have a specific type of attraction in mind (e.g. restaurants) though no specific one; they tend to head towards an area (e.g. specific road within inner city district) where they believe that they find many restaurants. This search strategy is the so called social zoning of cities, where maps are used to find clusters of certain types of facilities. In choosing an area with a lot of potential destinies the risk of failure and disappointment is minimized. At the same time tourists can easily compare different restaurants offers and thus avoid long walks between them. Within the SPIRIT project [17], Seester [33] investigates the research field of automatic analysis of spatial data. The objective is to identify spatial clusters by using the parameter “spatial proximity”, but other parameters such as thematic analogy see possible. In addition to simply showing the position of favored attractions by specific symbols on the map, mobile tour guides shall visualize those identified clusters by marking the social structure of the city. This is similar to the concept of aspect maps [3], but goes further by focusing on activities and themes in particular.

- topographic maps (presenting general overview)
- navigation maps (giving detailed directions)
- route maps (showing modality dependent routes)
- location maps (to locate oneself or others for orientation)
- proximity maps (details about near by facilities)
- thematic overview maps (activity based or historical maps)

It could be argued that most activity-based social zones are pretty much the same, simply spread somewhere around central city. This might be true in some cases. In most cases, however, there are great differences with respect to the distribution of certain types of facilities. [14] discovered in an empirical study in the city of Heidelberg that the spatial centre of gravity changes according to the tourist’s interests. While the western part of Old Town Heidelberg is stamped by shopping facilities such as warehouses and small retail stores, the main tourist attraction are concentrated on the east side. “Activity based”-maps that focus on particular activities or themes showing the “social zoning” of different areas can include the following:

- public transportation maps (railway, bus, taxi etc.)
- shopping map
- art and cultural map (museum area, exhibitions, etc.)
- night life map (bars, clubs, dancing etc.)
- restaurant map
- accommodation map
- event map (what is to be done now / today ?)
- sport and activity map
- car map (streets and parking)
- student map (university area(s))

The idea here is that not only facilities which are near by or within a distance are relevant to tourists, even more important are activity related issues. As a cartographic mean to capture those areas on a map, a specific layer shall present previously identified “areas of interest” (clusters of thematically related facilities) as circles or polygone [25]. Based upon those zones, only the relevant attractions of the specific topic could be presented or marked, in addition salient streets can be highlighted, etc. This way the social structure of a city can be visualized enabling an activity (or even lifestyle) related access to relevant information.

### *3.2.2 Navigation and Way-finding*

Research in way-finding has focused on several cognitive aspects – also in combination with map-use [20], [7], [10]. For pedestrians map use often differs from the notion of maps representing a straightforward tool for planning a route between two points. Finding the shortest and fastest way to a specific location is only one of many navigational tasks maps are used for. As [6] concludes from his ethnographic studies of city tourists, map use is often less about explicit route planning, but more about wandering in a city in a “roughly correct manner”. Routes used by tourists in the field study were more directional then specific. Without knowing where they were exactly going they believed to find something interesting in a particular “area”. Instead of following a specific route, they tend to follow a rather estimated direction. In this sense tourists use maps to locate and orientate themselves in order to reaffirm their approximation. Getting there is half the fun and solving the “way-finding problem” is part of the tourist experience, and sometimes enjoyment counts more than utility. These facts need to be considered in mobile tour guides and their user interfaces if these systems actually shall be accepted by these tourists. Tourists often use tours to learn in a structured manner about places worthwhile visiting rather than strictly follow their suggested path. Therefore tourist systems should present tours and attractions to allow tourists to learn from them. So far, most of the new and enhanced services for tourists include multi modal assistance for navigation. Signals will indicate directions to follow, possibly underpinned with voice direction commands. In addition acoustic signals are used to indicate that a user has gone off the suggested route. Almost any tourist information system provides tour planning functionality. But tours should not only show the fastest way from one point to another, but should also serve to promote the attraction of a city and to offer an structured overview of possible activities. One should distinguish between different tasks of finding shortest path, tour proposals, predefined routes, as it affects not only the content (displayed tour stations) but also bears implications for the graphical representation. Whereas in the case of finding the shortest path, additional objects can be presented in a highly generalized manner, in tour proposals or predefined roads, however, attractions along the path are quite important. Algorithms for personalized tour proposals have been presented by [41] (also relevant parameters have been identified there) and [16]. The sequence of the adoption process for generating such maps is presented by [37], [38].

### *3.2.3 Localisation and Orientation*

After deciding which sight(s) to visit, a first basic task of tourists is to locate the position of the specific sight and to correlate it with his / her actual position. To support this cognitive transition not only the tourist’s position and the position of the sight need to be displayed, but also landmarks near by [29]. The identification

of landmarks for orientation purposes represents one of the most common problems in navigation and sightseeing.

A common way to visualize the position of sights is to simply overlay icons representing the objects onto the map. To highlight these symbols various graphical variables are available as identified by [5]. In a mobile scenario the variable *size* and *color* seem to fit this purpose best. Highlighting and labeling important major roads near by are another useful hint for orientation purposes. This typology is accepted for paper maps, but needs to be enhanced for interactive mobile maps in order to reflect the possibility of animation, acoustics and interaction. These can be used to strengthen the communication goal of the map [20].

**Table 2. Overview of important variables**

| *Graphical variables* | *Dynamic variables* | *Acoustic variables* |
|---|---|---|
| Size | Time | Volume |
| Form | Duration | Pitch |
| Filling | Sequence | Register |
| Direction | Rate of Change | Timbre |
| Tone | Frequency | Sequence |
| Colour | Synchronisation | Duration |
| | | Rate of Change |

### *3.2.4 Proximity and Events*

By integrating the user's position it is also possible to redefine and filter the information search. Proximity adjusts the search results to the actual action space of the tourists, since only Points of Interest (POI) within a defined distance will be displayed. The search parameters need to support the displaying of all possible types within the search area or only one specific type. Another functionality using proximity as a trigger are so called push services e.g. location based pro-active tips [39].

A further step is the integration of time dependent information (see map task "events" in Figure 1). Either in combination with a proximity search or as a task of its own it is possible to visualize time dependent objects (e.g. exhibitions) or time critical objects (opening hours of museum) acccording to their actual accessibility. [30] gives first examples of how time dependency can have graphical implications on map production.

### *3.2.5 General information seeking and identification*

A general problem tourists often have to face when visiting unfamiliar places is to find information about different kinds of activities there. Gathering information about the destination often takes place before starting the actual trip and may include search strategies such as exploring the web, reading guidebooks or asking friends who have visited the place before (pre-visiting).

Before travelling, a lot of organizing is done by tourists including gathering information, planning activities in advance, etc. Numerous studies have focused on decision making in pre-travel planning. From a cartographic perspective Faby [12] investigates the significance of web based maps within the process of travel prearrangements. He identifies three major tasks, i.e. general information seeking, selective finding of tourist attractions and specific route planning. On a smaller scale these tasks also reoccur during travelling, since new information gathered during the trip may suggest redefining previous decisions. Typical search strategies include asking locals and other tourists or visiting the tourist information centre. Anyhow, in either case this process concludes in making decisions on what to visit by weighing out the personal attractiveness of different sites.

Closely related to "*find out what to do*" is to schedule the different kinds of activities. For example, opening hours need to be coordinated with public transportation schedules and so forth. When planning these activities, another problem arises: finding out where things are. Attractions are typically spread around the city and in order to minimize travel time, tourists tend to group sights together which are close to each other. Today most tourists still favour the combination of paper maps and guidebooks along their way. But to link the detailed information in guidebooks to the position of the sites on the map is time consuming, needs cognitive efforts and causes errors. Therefore an electronic guide providing thematically access to a database can give a first overview. In addition, it closes the linking gap by showing the respective sight on the map. A great advantage of digital maps is the possibility to spatially link not only text but multimedia to the objects on the map. e.g. via Geolinks as described in OGC-OpenLS [25] (for details see constituents of task "identifier" in figure 1).

As shown above, information retrieval is not limited to map use, but it serves to initiate succeeding tasks involving map use. This gives tourists the opportunity to inform themselves while waiting for or travelling with the bus, etc., since maps are often used in advance of getting to the place. In this case they serve as an educational function. A main aim of using a map is to gain sufficient information about a specific place, so that one can get around without actually using a map (mental map).

## 4. FURTHER FUNCTIONALITY OF MOBILE GUIDES

Since tourism is a social activity there is a demand for tourist systems to support this collaborative nature of tourism. Especially leisure travel is predominantly group based. While planning daytime activities for the day a lot of intra-group collaboration is done including which sights to visit, etc. In general, co-visiting is about sharing the visit with others, either with split up travel groups, between other unknown tourists or with people at home. An enhanced feature of mobile tourist services which allow interactive experience between tourists could be as follows:

- supporting coordination between travel groups by allowing them to communicate their location or additional routes, attractions, recommendations, etc.
- sharing a visit with other tourist at the destination, in a sense of a tourist "buddy finder".
- sharing with other people at home via web.

Whereas pre-visiting is about planning, post-visiting is about documenting and sharing experiences. Tourists are usually excited about what they have seen. The popularity of photographs shows the importance of this aspect. Guidebooks and printed maps offer the benefit to serve as a reminder and souvenir of the holiday. Therefore services should offer features that allow tourists to document their trip, e.g. by saving maps with a walked route etc. A prototype that enables tourists to build travel–based websites is "Travelblog" [6]. Entries can consist of pictures, videos and text, which are emailed from a mobile phone. As another example the mTG "Scrapbook" [23] also supports diary functions.

## 5. CONCLUSION

Yet, most tourists are still comfortable using traditional paper maps and printed tourist guides in order to explore their environment. Mobile tourist services need to match with traditional information media and provide additional advantages. Certainly, tourism presents potential for the use of new mobile technology and tourists have already adapted to the www, mobile phones and cameras, the latter being the most successful tourist technology so far. In our opinion, new tourist systems need to provide task based functionality and equally important task oriented visualisation, e.g. of maps. This includes, that mobile tour guides not only should provide information, but trigger actions supporting tourists to translate them into activities.

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