# Romlig stedfestede fortellinger fra mobil GIS, eksemplisifiert ved H. C. Andersen i København

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Principles of a mobile GPS-enabled GIS acting as a tourist information system are discussed and exemplified with special focus on the narrative aspects of tourist guidance. Flexible adaptation to user movements is accomplished by providing information about objects that the user passes as well as site-specific 'narrative links' to new locations that the user may choose to visit. The strategy is expected to enable an enhanced travel experience for someone heading for a specific destination while still providing the basis for 'explorative detours'. The principles are illustrated through a case study of H. C. Andersen's residences in Copenhagen.

*Key words*: Mobile GIS, narrative links, H. C. Andersen in Copenhagen

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## Introduction

This paper examines the potential of a GPS-enabled GIS acting as a mobile tourist information system with special focus on the narrative (story-telling) aspects of tourist guidance. The rapidly expanding use of palmtop computers and portable dedicated systems for in-car mobile navigation raises the issue of further utilization of their GIS core to provide information about the area near the travel path. A GPS-enabled mobile GIS could present stored attribute information about nearby objects, according to specified user preferences and interests, be it for architecture, historic landmarks or birth places of famous writers. The attribute information in question could range from simple building age attributes from a GIS building layer to actual tourist information systems based on sets of objects selected to suit tourist segments with specific preferences or backgrounds.

The actual means of communicating the information would need to reflect the situation of the traveler. Car drivers may prefer sound messages, while a person on bicycle or walking has better opportunities to stop and read text and images displayed by the system.

A central issue in this context is whether the system should guide the user along specific pre-defined routes that enable a desirable sequence of visits to selected landmarks. This is similar to the traditional tour suggestion maps in guide books. Alternatively, the user could 'guide' the system by making route decisions independent of the information system. This will require a system that presents relevant information about any object that the user happens to pass. The underlying assumption behind the work described in this paper is the belief that mobile information systems should above all be flexible and respond adeptly to any travel path taken by a user who may be traveling through an area for some other purpose.

The results presented in the paper focus specifically on how a system may respond in a flexible way to the de-facto travel path taken by the traveler and still - by using so-called narrative links - be able to suggest new locations to visit as a relevant continuation of the information obtained at the current location (see Fig. 1). This can be viewed as a hybrid of the two extremes mentioned above, enabling an enhanced travel experience for someone heading for a specific destination while also providjng the basis for 'explorative detours' if the user so desires.
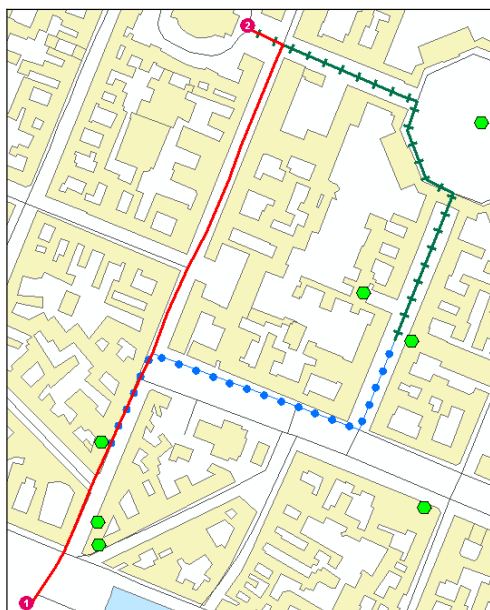
*Fig. 1. Solid path from (1) to (2) indicates a planned travel route. Path with circle symbol indicates a narrative link received when passing an object. Path with hash symbol indicates a subsequent route towards destination, possibly provided by the standard navigation functionality.*

## Background

The work presented here builds on a prototype GPS/GIS-based software system described by Møller-Jensen [9]. This paper addresses the issues of scope of information relevance as well as how presentation of information is constrained by the speed and direction of the user. Being able to match the timing of the information to the spatial scope of the information relevance while moving is seen as an important aspect of such systems. Relatively few papers have described efforts to further utilize the potential ability of the mobile GIS to provide elaborate attribute information about any object with which a user interacts while moving around. Jiang & Yao [5] provide an overview of definitions, concepts and potential applications related to location-based services within a GIS context. Frank et al. [3] describes a transformation of the traditional GIS into a Location Based

Service by providing mobility, distributiveness and egocentric awareness. The general problem of selecting the physical object for which to receive information in a given spatial context, the equivalent of the human action of pointing, has been examined by Egenhofer [1]. IST [4] describes how GPS-enabled city guides are already used in the travel industry and argues that the «culture and history travel market,» especially, will be able to benefit from a strategy of location-sensitive presentation of object information. Liu & Karimi [8] present algorithms for predicting the expected future travel path of a user from the current location based on long-term and short-term historical trajectory data sets.

Møller-Jensen and Hansen [10] address the issue of visible versus invisible physical objects surrounding the travel path and argue that GPS-supported information systems may be particularly well suited for providing the traveler with historical information related to objects that are presently either removed or lack visual indications that they may be of interest. It is worth comparing the concept of visibly interesting objects for tourist information with the concept of salience of features which was applied by Klippel & Winter [6], Nothegger et al. [11] and others in the context of automatic identification of landmarks to provide navigation support. One difference is the need for the navigation support algorithm to find objects on-the-fly that for some reason «stand out» from their close surroundings, while the objects represented in the tourist information system would be classified *a priori* as being of absolute interest within a given domain.

The technical implementation of the current prototype is not designed to take advantage of the high suitability for transportation that characterizes palmtop computers. The prototype is based on ArcMap from ESRI and runs on a standard laptop computer equipped with a GPS. Implementation on a PDA pocket-PC platform should not present any major technical problems. Future issues may involve data management, in particular whether data should be pre-stored on the device or could be transferred real-time based on the GPRS technology or future wide area wireless ADSL, as discussed by Kwan & Shi [7].

Traditional guided tours or excursions have certain distinct properties: The travel course is normally pre-determined to optimize contact with interesting sites. This can be expressed in terms of 'sites per hour', 'order or presentation' etc. Moreover, the information passed on to the participants is optimized to fit the actual time frame available. Information may be presented several minutes prior to the actual physical contact in order to introduce the object and build up expectations, In some cases giving prior information may compensate for a time window for actual contact is, for practical reasons, much smaller than what is required to provide adequate information.

On the other hand, the user may not be prepared to submit to the time and distance constraints set by a pre-defined tourist route. The user may travel for purposes other than sight-seeing, maybe following a 'quickest route' set out by the routing functionality of the GPS unit. He or she is interested in attribute information about the surroundings to enhance the travel experience while moving towards the destination. A system that adapts completely to any user movement may, however, be incapable of providing adequate information about an area simply because the user's path (unaware to the user) may not pass by the sites that are of most interest.

**The concept of narrative links**

Narrative links are suggested here as a compromise between the two strategies. These are simple location pointers stored in the attribute table of an object layer that indicate other locations within the same information domain that could be visited by the user optionally and subsequently. They can be seen as a kind of spatial hyperlinks.

A set of narrative links are presented to the user when he or she passes one of the objects represented in the system, either by chance or by being directed there by a previous narrative link.

The idea is that fragments of a spatial narrative – a story related to the surroundings - could be created by following these links if the user decides to do so. It is an advantage that this pursuit of further information by altering the route is optional to the traveler. The narrative links are selectable according to user preference. Alternatively, the system can continue to provide information related to the original route.

The experimental system described in this paper implements several types of spatial references or pointers that can be used as narrative links. The keys parameters are themes, distance (nearness) and chronology. A pointer is based on either nearness or chronology within the context of a specific theme. The themes are the result of a classification of spatial objects into categories that reflect the specific interests of the traveler or an otherwise desirable grouping of objects with common properties. Any object may fall into several themes. A building, for example, may be both architecturally interesting and the birth place of a historic person.

Let us assume that the user is passing by an object that is represented with attribute information in the system. The following strategies for suggesting the next object to head towards are applied by the system. The first step is to establish the relevant theme or set of themes to follow, based on the themes associated with the object at the current location. The user may narrow down the set of interesting themes *a priori* to only a few. Alternatively the used could decide on the spot which theme to follow, if more than one is registered, given that the user wants to take an explorative detour. Having selected a specific theme, the system may make suggestion based on chronology (if the necessary sequencing data exists) or nearness. In the first case, the suggestion could be either next or previous in the chronological sequence or the first objects in the sequence. In the latter case, the suggestion would be the nearest object belonging to the theme in question that has not been visited previously.

This general description above can be exemplified using a case related to the life of writer H. C. Andersen in Copenhagen. Let us assume that the user has just passed a former house of residence. The linking process could then express some of the following guiding sentences, stated in informal everyday terms:

– if you want to see another place where he lived, there is another house of residence just around the corner (theme/nearness).
– if you want to see where he lived when he arrived in Copenhagen, take this route to place X (theme/chronology/start)
– if you want to see where he lived just before/after this place, take this route to place Y (theme/chronology/previous or next)

A practical feature is that the system does not direct the user toward objects that the user has already visited the same day. It also avoids going into a loop by pointing back and forth from the same two objects. It is therefore necessary for the system to maintain a log of visited objects. Moreover, the system needs access to the least-cost route between all objects and not just the closest which may already have been visited. These routes may be pre-identified and stored, but it seems more reasonable to compute them on-the-fly, if navigation functionality is also present in the system

### The case of H.C. Andersen in Copenhagen 1819-1875

This particular case is appropriate to illustrate the potential behavior of narrative links for several reasons. The number of relevant sites within a relatively small area is high. The sites can be categorized into sever-

al themes reflecting various aspects of the writer's life in Copenhagen. Moreover, there is a wealth of detailed sources of specific history related to each location. Several map books contain suggested H. C. Andersen tours through Copenhagen, due to the 200-year birthday celebration in 2005. The user of the proposed system is assumed to be a visitor with greater than average interest in the life of H.C.Andersen and who may have preferences for specific aspects of his life.

A reference map has been established indicating the location of more than 50 sites in central Copenhagen. Each site has been classified into one or more of the following themes or categories:

– Arrival in Copenhagen 1819
– Residences
– Friends and Supporters
– Cultural institutions
– Young H.C. Andersen
– Old H.C. Andersen
– Places of inspiration for fairy tales

Fig. 2 shows the location of the total set of sites, except for a few that are not in central Copenhagen. Two themes have been selected from the total set for further illustration: 1) the places of residence and 2) sites related to friends and supporters.
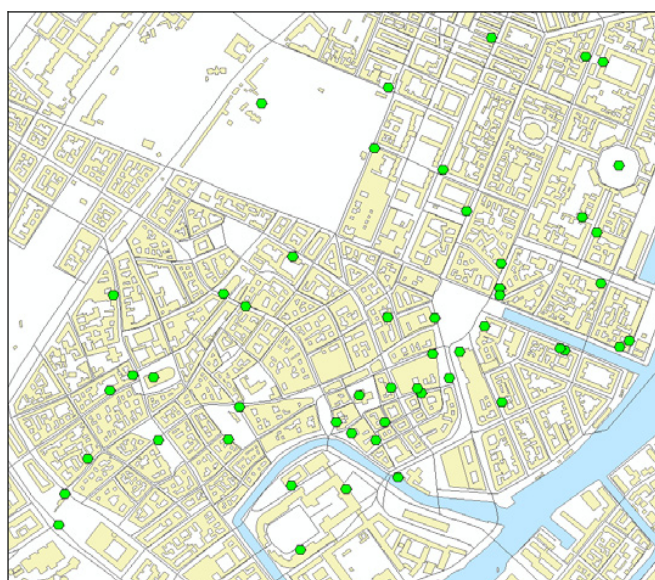


*Fig. 2. Map of Central Copenhagen. Points indicate sites related to the daily life of H.C. Andersen*

As previously discussed, the order of the visits to the residences may reflect either ease of access (nearness) relative to the current location of the visitor or the chronology of H. C. Andersen's occupancy of the locations. The latter strategy may provide an experience of following H.C. Andersen through the phases of his life.

The friends and supporters are in many cases famous themselves in a Danish context, being co-responsible for the 'golden age' label attached to the first half of the 19th century. Others are primarily known because of their relationship with H.C. Andersen. Getting to know where these people lived in Copenhagen develops an understanding of the daily trips and whereabouts of H.C. Andersen.

Although some of the people in this category were associated with the writer within a specific time frame, the span of years is usually so long that chronology is of limited relevance in this case. Some of the people could be assigned to a 'young Andersen' category and others to a 'old Andersen' category, but it is assumed here that the order of visiting sites falling within this theme will not have much effect on the narrative aspects.

The important process of identifying zones of information relevance is not elaborated in this case study. As described in Møller-Jensen & Hansen [10] these may be based on buffer zones around each object or on a more sophisticated visibility analysis. These zones play an important role in determining the selection and timing of the attribute presentation. For further elaboration of this issue please refer to Møller- Jensen [8].

Fig. 3 illustrates how least-cost routes between all sites falling within one or both of the categories are computed using the network analyst functionality of ArcMap [2]. The length of each route (through the road network) is stored in an origin-destination matrix. This allows the system to suggest for further exploration the nearest object that has not already been visited.

The example below shows preliminary results from ongoing experiments with the prototype version and the H.C.Andersen case. Fig. 4 and 5 illustrate the following situation:

Visitor V has initially indicated an interest in the residences of both H.C. Andersen and people associated with him in Copenhagen. By chance, V passes the former residence of H.C. Andersen in Nyhavn 20. Information is now presented to V as illustrated in Fig. 4. The actual place of the information dissemination depends on several parameters including V's travel speed. V may subsequently choose to continue towards his initial goal or to examine related sites.
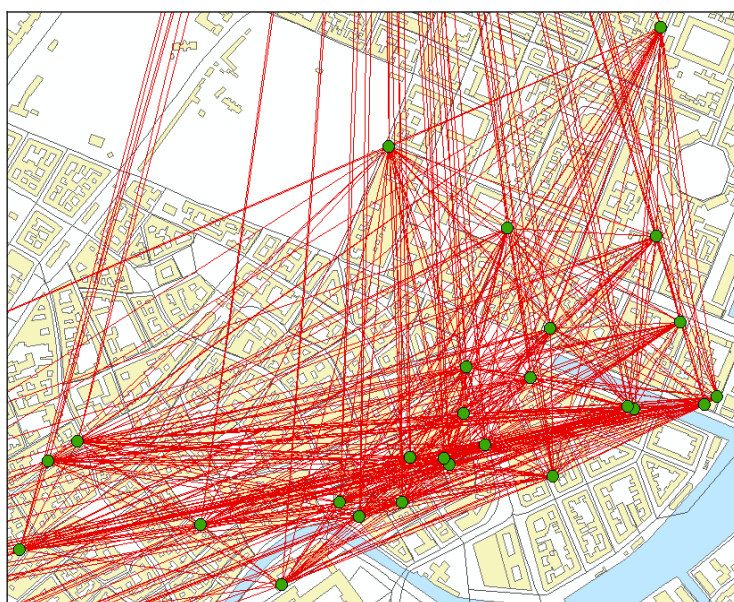


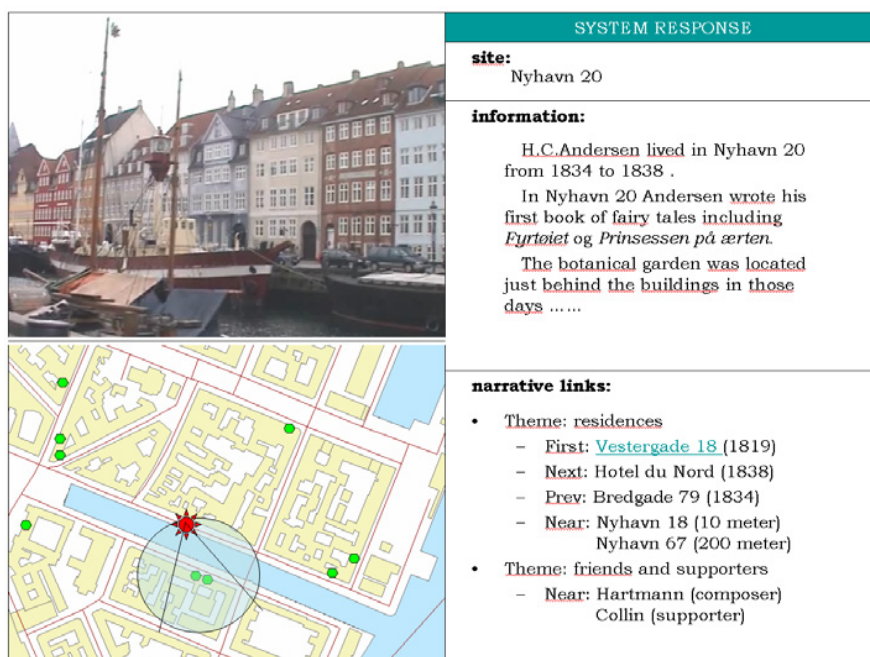*Fig. 3. Network distances between all objects are computed and stored in an OD-matrix*

*Fig. 4. Left part: User's location in Nyhavn (indicated by sun symbol).*
*Right part: Information and narrative links related to the site Nyhavn 20. Circle*
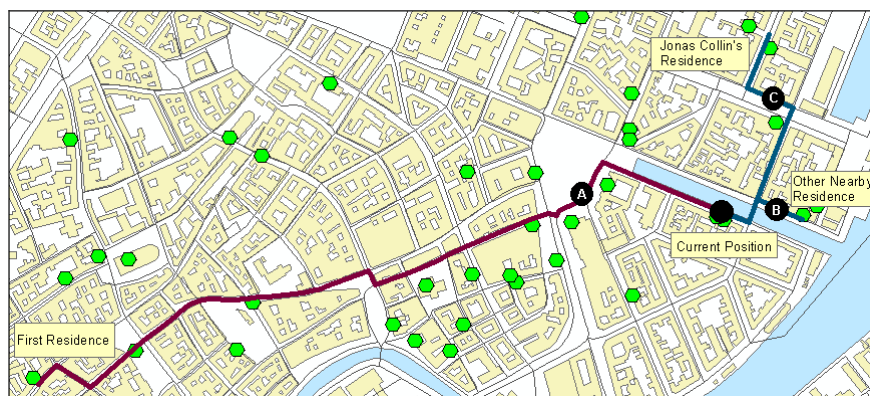*indicates zone of information relevance.*



*Fig. 5. Shortest routes towards the objects suggested by the narrative links at*
*Nyhavn 20: (a) first residence after arrival, (b) nearby place of residence and (c)*
*former residence of supporter Jonas Collin.*

The system suggests the following sites as relevant next visits, based on the stored narrative links:

– Since H.C. Andersen stayed in Nyhavn 20 many years after his first arrival in Copenhagen, V may choose to examine this thread in-depth, by traveling to the very first residence in Vestergade 18, see Fig. 5(a). Using the chronology approach, V may subsequently be directed from the first residence to the second, if this has not already been visited.

– Since Nyhavn 20 is close to other residences in Nyhavn 18 and Nyhavn 67, where H.C. Andersen stayed for more than 15 years, it would only take a few moments for V to see one of these places also, see Fig. 5(b).

– Since V is also interested in the Friends and Supporters, V may choose to visit the former residence of his primary supporter and father figure Jonas Collin, which is nearby, see Fig. 5(c).

## Conclusion

The general objective of the approach described here is to enable a flexible adaptation to user movements while at the same time providing the basis for suggestions by the system that may help the user experience a more 'complete picture' compared to a random route selection.

The narrative links do not involve any specific optimization concerning the overall direction of movement or for visiting many sites per traveled kilometer. These features would potentially be characteristic of planned guided tours. With the current implementation, there is therefore a risk that the user will experience some back and forth movements if he or she chooses to follow the links chronologically. This may be seen as a natural consequence of the desire to experience sites in a sequence that enhances the understanding of a historical process, for example.

The alternative, expressed as «I might as well see this also, now that I am in the area» is somewhat supported through the narrative links pointing out nearby objects, but only if these objects are within the selected categories. There is clearly a trade-off taking place. In some cases it would make sense to visit all sites within an area before moving on, even if they belong to different narratives. This may be the case if the most suitable object is far away compared other sites within a short distance, or if the user has limited ability to travel.

If focusing on a system that suggests interesting detours within the context of navigating a user from one point to another, it may be worthwhile to consider implementing direction awareness. The links presented to the user are then selected such that any detour taken still brings the user closer to the target.

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