Digital Paths to Medieval Naantali
From Mobile Information Technology to Mobile Archaeological Information

Isto Vatanen[1], Hannele Lehtonen[2] and Kari Uotila[3]

[1] Åbo Akademi University and University of Turku, Turku, Finland.
isto.vatanen@abo.fi

[2] Muuritutkimus ky, Kaarina, Finland
hannele-maria.lehtonen@pp.inet.fi

[3] Archaeology, University of Turku, Turku, Finland
kari.uotila@utu.fi

Abstract. While a considerable number of mobile computing applications for cultural and archaeological heritage presentation have been developed, the characteristics of archaeological information and processes of transferring it to the mobile context have received considerably little attention. The question of how the archaeological data makes information suitable for the general public is discussed in the context of an on-going R&D project in Naantali, Finland. The process of examined by discussing some fundamental characteristics of archaeological data, and the information aimed for the general public. On the basis of these characteristics and suggested functions of the information, a framework for a flexible data model is introduced to increase the efficiency of the information process. The data model addresses especially the problems of parallel information, management of changing interpretations and flexible updates.
Keywords: mobile computing, information management, information process, archaeological record, popular information

1. Introduction

Advances in mobile computing technology since the mid-1990's have entailed a profusion of academic and commercial projects aiming at producing and deploying handheld guiding and presentation systems for cultural heritage sites.[1] Even if the work so far has concerned many important issues from the mobile technology to the presentation and user experience in a mobile environment, most of the presented systems do tend to have been concentrating on a rather superficial level if one thinks of the vast dimensions of the whole mobile information environment. As already recognised in the sense of ubiquitous computing, mobile information systems are not only technical frameworks incorporating location awareness and a user friendly interface for presentation of data using a portable computer (e.g. Cheverst et al. 2000; Marty et al. 2003: 277–279; Grinter et al. 2002). The steps taken so far have been important ones, but not quite enough for exploiting the possibilities of the mobility of information. An upcoming major concern in making an effective and efficient mobile information system is the mobile information and its social dimensions rather than the technical system.

According to the general needs, a focus on the specific issue of efficiently delivering archaeological information in context to its audience is essential. This article addresses the issue of how the archaeological heritage information could be delivered with maximum impact in a mobile information environment and more specifically how this delivery could be done in a way that is feasible both for the information providers (i.e. archaeologists), organisations (museums and cultural heritage administration) and the end-users (the general public) (Skeates 2000: 118). The emphasis is on the optimisation of the process of delivering suitably situated and contextualised information for the general public instead of barely presenting pre-existing data. The important premise of the process is that the presented information should be based as largely as possible on the direct information produced during the first phases of a research project to emphasise the importance of a rapid communication of archaeological fieldwork research results to the public audience (Thomas 1991). The approach taken is to introduce a prototype of a flexible datamodel for management and storage developed for a mobile information access framework. The span of the process discussed ranges from the fieldwork and data gathering to the various requirements of data storage, scientific and administrative use while the emphasis is on the public presentation having been the main focus group in the work discussed. The present research has been done within the framework of a project aiming to develop a mobile multimedia information system for the Town museum of Naantali, in southwestern Finland.

2. The Naantali Project

Naantali is the fourth oldest town in Finland. This medieval town is located near Turku on the southwestern coast of Finland. In 1443 king Christopher of Bavaria gave an order for the founding of a Brigittine convent on the cape of Ailoistenniemi in Naantali. He also gave privileges to a town that began to grow next to the convent. The Reformation in the 16th century destroyed the Catholic convent and it was closed. Previously it was thought that the town was deserted at the same time, but the new excavations in 2000 and 2002

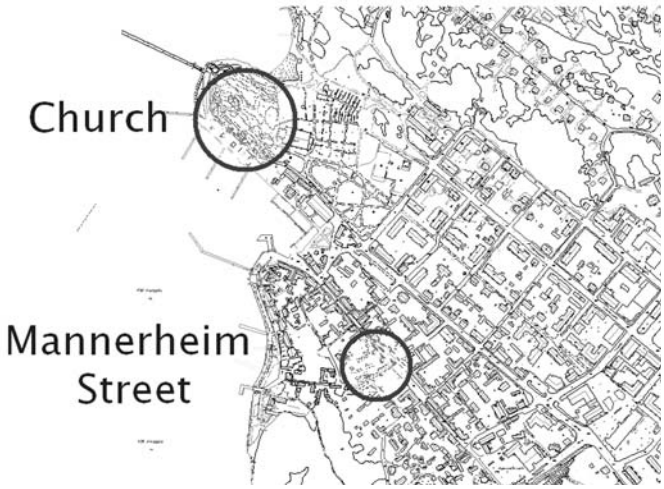

Fig. 1. Old town of Naantali.

Fig. 3. Old town of Naantali.

revealed contrary evidence. It seems that the settlement on the main street Mannerheiminkatu actually grew in the late 16th and early 17th century instead of vanishing.

The oldest archaeological studies in Naantali have been made in the area of the convent. The first excavations in old town and in Mannerheiminkatu were conducted in the 1980's. The sewerage works carried out on Mannerheiminkatu in 2000 and 2002 offered a new opportunity to study the past of Naantali. The results of the excavations were remarkable; in 1648 the town was given a new town plan. The old houses and the main street were pulled down. The remains of the buildings were still under the ground. In the excavations area there were two bases of wooden houses and a lot of artefacts, which did belong to these buildings.

From the beginning of the excavations in 2000 and 2002, the chosen method for fieldwork and documentation was digital surveying carried out with total station. At Naantali excavations all soil layers, excavations units, profiles, sections and structures were surveyed digitally and all observed deposits were measured as stratigraphic units according to the principles of the Harris matrix.

It is hard to understand what is being studied because the traces of the past can be very weak. With the help of 3D modelling this kind of almost destroyed evidence of life in the past can be brought back to life and given a more comprehensible form than that provided by plans and sections of excavation. The excavation project group has written a book about excavation in Naantali presenting the site from different angles by using computer-graphics-based illustrations along with more traditional photographs and illustrations (Uotila et al. 2003).

The current project discussed here launched in cooperation with Naantali town Museum is a continuation of the work of presenting the site to the public in a more concrete form.

Alongside the scientific aims discussed here, a more practical aim of the project is to develop a working prototype information system offering school pupils and tourists an opportunity to visit the excavated sites by using a tablet-PC device as a user interface. Usually there are no visible signs left of excavated areas, even when the site was interesting and had given new information about past. However, the tablet-PC and its multimedia together with a GPS unit, does offer a new opportunity to get to know the sites in Naantali. When a pupil or tourist arrives at the excavated site, the software may give correct information on different locations by incorporating the location information provided by the GPS unit.

Fig. 2. Mannerheiminkatu in Naantali during the excavations.

Fig. 4. Prototype of the information system being tested in Naantali.

3. From Data to Information

The initial challenge of enhancing the process of presenting an audience information which is relevant from their point of view lies in identifying critical differences between the initial data and the end-user information. Studies on information needs of different user groups such as social scientists (Line 1969), journalists (Nicholas and Martin 1997), humanists (Wiberley 2003) among others, have been conducted in numbers for a few decades, but in this case a rather more specific approach is needed to adapt the characteristics of the information with the process from which they resulted. From the information management point of view the inherent problem with archaeological and other cultural information is the subjectivity and highly contextual nature of the premises according to which the mostly quantifiable source data is used to construct highly qualitative information (Jones 2002: 2). In simple terms, data acquired during any single excavation, only consequentially results as information on the past cultures. The same phenomenon applies to any quantitative research with an exception that an archaeologist is only seldom able to rely on acquiring more data perhaps by some other complementary methods, if faced with a situation where the studied site does not give all the answers. Therefore, the throughput of the information process becomes especially important in the archaeological context.

At this point it is important to emphasise that the view presented here of the different aspects of archaeological information, of the archaeologists and the public as information users, is overtly simplified to explain the findings of the research discussed. The intention here is not to draw a complete picture of neither, but to concentrate on some of the crucial factors affecting the efficiency of the information process of making archaeology available to the public. Within the scope of this article the most interesting characteristics of the information artefacts are those which do reflect the amount of processing needed before a piece of information fits a purpose of an end-user. Therefore the closer examination of the content is concentrated on the two ends of the information process, the two phases where the data is most actively processed by human operators, the documentation and the presentation.

Considering a fieldwork project, whether an excavation or a survey, it is evident that the material gathered during a field season and post-excavation work is the result of collecting a sample of the original and also of the potentially available data. A closer discussion on the actual dimensions of this general notion has to be omitted here, but regarding the process, the most significant implication is that the corpus of excavation data may not be considered either complete, stable or incremental, and only seldom even conditionally representative when thinking about archaeological cultures. (Schiffer 1987; Patrik 1985) The site and the information actually become more and more fragmented both physically and on the interpretative level. (Jones 2002: 44–45) A site has to be documented within certain temporal constraints according to a determined policy of what should be done and what is possible to do. Even though the fieldwork incorporates a lot of interpretations and choices, the eventual answers to the more precise questions are formulated only afterwards. The notion underlines the eventual instability of the initial but also the subsequent information structures.

Another important aspect of the initial data is that it is collected only partially to an extremely precise and explicitly expressed direct scientific or scholarly need. In fact, the nature of archaeology prevents it. Pure research excavations do naturally have more clearly expressed and far-reaching scientific and scholarly goals, but as an inevitable aim of all salvage operations has to be the preservation and documentation of all archaeological heritage within a given area: the more or less definite need for information formulates as an attempt to find out as much relevant information about the site as possible. Even if an excavation is launched because of an explicit, or implicit, information need or interest, the data gathered during the actual project is more or less constrained by the imperatives of documenting, digitally or manually, everything in acceptable detail, and of that the archaeologist has to take what is to be found in spite of any predefined intentions (Richards and Robinson 2002). In practice most of the interests and needs develop only during the actual work. Furthermore it is often impossible to extend the field project as far and as deep as necessary for purely scholarly purposes resulting that even an explicit need becomes only partially answered during a single project.

The third aspect in addition to representativeness and the available information-needs ratio of the data, as the research effort discussed here did focus, is the direct usefulness of the data for individual end-users. Even if an archaeology professional will be able to interpret excavation documentation relatively well, the basic data is still likely to be highly relevant only to specialists well acquainted with the given material. For instance pottery of a relatively narrow period or structural remains of wooden buildings in medieval southwestern Finland will interest mainly specialists, much less the general public, which is the audience of the project discussed here.

As it has become evident, the relatively raw data is not as such suitable as information for the general public. Some of the general characteristics of the end-user information are that it is an aggregate based on numerous information sources; it is supposed to lead to basically rather developed interpretations about the whole past society; it should be, at least partially, based on the estimated interests of the visitors and the educational goals of the professionals; it generally is not sophisticated and detailed enough to satisfy researchers' requirements; and it is focussed on the key aspects of a phenomenon and generally with a relatively low level of detail.

Despite the indicated differences it is important to emphasise that the archaeological record does share some common qualities with the information presented to the public audience. The import remains largely the same while the differences tend to centre around the scale, volume of context, and the degree of interpretations. Therefore it becomes imperative to examine the process also from the functional viewpoint.

4. Functions of Information

Regarding only the characteristics of information at the two ends, the main issue in the information process is that re-working of the content is needed. How this should be done is an additional question, which could be further elaborated by considering the functions of the two categories of information. The immediate primary goal of the data acquired during a field work expedition is to secure material for research and to document archaeological sites and artefacts to preserve them, if possible as they are, but at least in the documents (Richards and Robinson 2002). Goals of the information presented to the public audience in a museum display or at a site are rather different. The end-user information does have similarly more immediate functions, comparable to research and management, but also more difficult to determine, longer term educational and social functions.

Considering the functions and the process it is evident that functions of archaeological data have to be supported in the sense of retaining it in a form that fulfils the initial requirements. On the contrary, the functions essential to an end-user have to be constructed during the process. The priority is to satisfy the immediate functions first and then using this information to address the longer term goals. Opposite to the traditional argument suggesting that a major benefit of new technologies in the delivery of cultural heritage information, is the possibility to present large amounts of additional text, (Roles 1995) our findings could suggest that the benefit is instead in presenting same amount content to a larger public in a more meaningful manner.

During the project a set of immediate functions for information in a mobile context were identified. The functions were classified into three categories. The first primary function is orientative in spatial (where am I, where can I go, where should I go) and temporal (how old is something, how long does it take...) sense including comparisons within the scope of the context. Instead of confining the sphere of orientation to the physical space (Ciavarella 2003), we argue that the intellectual orientation function discussed by Davies (2001) in the context of an art museum, does function in a mobile guiding system built for an extended museum environment (Vatanen et al 2003), simultaneously with the present surroundings and its historical dimensions. The second function relates to the provision of meaning of the archaeological site (surroundings) and the meaning of different artefacts and phenomena within the context of the site. The third function is more general covering individual special interests and contextual functions regarding the archaeological site more related to a visit such as the possibility to visit different locations in varying weather conditions. The functions discovered compare with classification of information needs presented in previous studies (e.g. Line 1969; Nicholas and Martin 1997). A rather direct analogy may be drawn between the Chang and Hung study (2003) omitting the third category referring to managerial functions of information.

5. The Process

In the observations, several essential premises for better understanding the process of delivering information about an archaeological site to the general public were identified. In short the process should produce suitable end-user information meeting the mentioned primary functions efficiently, which generally implies that it would be desirable that the process is as cumulative as possible, allowing extraction of the initial data from the aggregates, resulting in as little unused information as possible, producing intermediate aggregates which could be used as bases for further information, and providing flexible support for content and ontology level reinterpretations. An outline of the process and factors is presented in figure 5.

Reflecting the ideal state of conditions with the state of affairs during the excavations in Naantali, the spatial information acquired is possible to process in a manner, that follows relatively closely the general requirements. The excavation measured completely using a total station results in three-dimensional points and lines ready to pass to AutoCAD for post-processing, MapInfo for analysis and to 3DS Max for modelling and preparation of visualisations. The process results in only minimal non-used information and backwards movement to the original data is rather easy. The same notions apply to the photographs, illustrations and video films, mostly requiring rather simple editing and enhancing.

However as the actual problem of passing meaningful information is not in presenting different media artefacts, but communicating their meaning, a more universal approach for storing the data is required. The suggestion proposed on the basis of the observations from the Naantali project, is to introduce a data model consisting of individual spatially oriented information objects with loose semantic linking

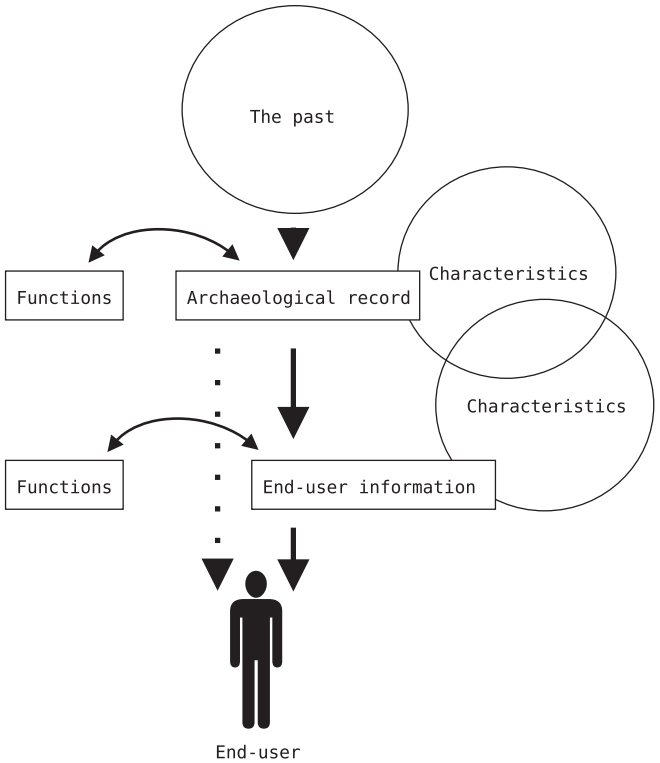

Fig. 5. The factors of archaeological information process.

which are based rather on a loose set of linking opportunities than a rigid semantic structure. One further requirement for the implementation of the model is rigid versioning system and an ability to keep track on the authorship.

6. Data Model and Loose Linking

The data model developed is based on a network of individual, spatially oriented data objects used for describing different artefacts, structures, spaces, periods and phenomena. Each object has a unique identifier, general descriptor fields, links to media repositories containing e.g. images, video and hypertext. While the reference device is a tablet-PC, client applications on operating on different platforms may choose the appropriate repositories on the basis of network bandwidth, audio and video capabilities of the device or the user's preferences. The important feature of the data objects is that the data attached to an object is kept in original format and therefore the contents may be edited on-the-fly without affecting the integrity of the objects. The number of different versions of individual media artefacts is not limited and by describing the differences between individual versions all the old, new, more and less precise or research-oriented, the information may be kept attached to the information object.
The suggested data model offers a number of benefits for the archaeological information process. The data repository is cumulative and the previous versions are always available making backwards reasoning easier. The model also makes possible to present alternative interpretations, versions for different audiences and client devices based on multiple variables. The modular approach with versioning supports collaborative work even at distance and storing all the data structured with a common framework does simplify the overall process.
The concept of loose linking is referring to the manner in which the data objects relate to each other. In the connection module within each object it is possible to define a set of positive links implicating an unconditional yes for the system to link this object with similarly described objects, and negative links implying for a definite impossibility to link another object with defined qualities. The linking is based more on a careful analysis of the data objects and their content than on forcing precise semantics even though increased clarity in expression certainly does make the linkage more precise and reliable.
An elementary example is the case of temporal references. In the following schematic example the data object is attached with loose positive links to the Late Middle Ages, Early modern period, 16th and 17th centuries while loose negative links refer to Early Middle Ages, and the 18th century.

```
<CMObject>
...
   <CMLinks>
   ...
      <CMLink cat = "dating" la = "en-uk"
      context = "fi" bind = "positive">
            Late Medieval
      </CMLink>
      <CMLink cat = "dating" … bind = "positive">
            Early Modern
      </CMLink>
      <CMLink cat = "dating" … bind = "positive">
            C16CE
      </CMLink>
      <CMLink cat= "dating" … bind = "positive">
            C17CE
      </CMLink>
      <CMLink cat = "dating" … bind = "positive">
            Early Medieval
      </CMLink>
      <CMLink cat = "dating" … bind = "positive">
            C18CE
      </CMLink>
```

The implication of the presented coding is that the artefact dates most likely to 16th or 17th century, being the transition period between the medieval and the early modern in the Finnish context. The confident dating of the artefact been considered not to be as late as from 18th century or as early as from the Early Medieval period. On the other hand its dating to other periods is not definitely restricted meaning that a possibility may be suggested that the artefact could be, somewhat improbably though, from the High Middle Ages or that it is a modern replica.
The practical implementation of the data model is an XML-based data repository distributed on each individual client terminal and maintained on a server responsible for serving the mobile client terminals with updates and upgrades on the software application and the data repository and security services for the network. A fully network based approach without stored local data on the clients was considered, but rejected because of the considerable bandwidth demands on a growing number of devices on the network and the eventual inability to guarantee network and positioning functionality all the time around the town for instance inside larger stone buildings such as the church.

7. Conclusions

The study presented indicates that the most pressing difficulties in developing mobile information infrastructures for archaeological research and presentation, are the limited knowledge about the information and its characteristics in the digital workflow. By rethinking the work process by focussing on the premises of creating and using information artefacts, is possible to find new ways to store and manage archaeological information in a more information-oriented manner taking more precisely into account the methods and habits of the information producers and consumers.

Notes

[1] See e.g. the proceedings of the CAA, ICHIM and VAST conferences from the late 1990's to the present; Walter, in Tourism Management 17(4) 1996; Cheverst et al. in CHI

Letters 2(1) 2000; Oppermann and Specht in LNCS 1927 (2000); Grinter et al. in the proceedings of the CSCW 2002; Zancanaro et al. and Ciavarella et al. in LNCS 2795 (2003) to mention a few.

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