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Revealing Hidden Histories with Modern Technology

Archaeological Information Systems and Geolocalization

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Abstract: It has been long since it was enough for museums to be simply repositories of objects and hubs of research and knowledge. Public education and sharing of knowledge has always been part of museum ideology but today many museums are striving to engage and enthrall their audiences in a world filled with pastime entertainment. Nonetheless, this challenge is not novel but one of the fundamental questions of museum pedagogy: How to present past and distant cultures as lived histories, as lives lived in places and environments now either empty or over taken by new inhabitants and their way of life? How to present the world stored inside the museum as interconnected with the living, changing everyday world outside? In archaeology you can sense the history of an object. After digging carefully an ancient house takes shape and there near the entrance is a loom weight. Maybe discarded in favour of a prettier one, or one with a more suitable weight. On the excavation in the middle of the remains of ancient buildings history becomes almost tangible. Who lived here? Who decided to discard the weight? The problem is, how to transfer this sense of connection and of real life in past ages into a museum? How to take the museum out of the building and to integrate knowledge of the past in the places where history happened? The purpose of this paper is to present solutions to these questions using modern technology to bring information back to the public domain. The presented methods include usage of 3D-technology and augmented reality with geolocalized information in the spirit of geocaching.

Keywords: History, AIS, Geolocalization, Museum

Museums and Histories of museum objects

Setting the Scene

In modern life, in a modern city, people are cut off from large parts of their history. History is packed away in neat books and museums and trips to see a ruin or for the most adventurous an archaeology-themed holiday. Our history is however a wide open field, a landscape with depth and nuances that suffers from being condensed and unified. On excavations each of us can feel this profound connection to the past where we came from. It offers us new insights about how much and how little life has changed in the passing millennia. We are often asked what we give back to the public, what use archaeology is and this is one of the ways we can give something crucial that no-one else can give. This is the insight we want and we need to share with the public, that history was once alive and it was lived by individuals very much like us. Especially in these days when so many people build their fences higher and try to divide us into us and them, it would do everyone good to get a sense of how young our countries are and how much common we share with our neighbours. How can we achieve this? A single arrowhead found on a field might give a child more sense of

connection to the past then all the history-books in school. The challenge is how we can present the history of our world to the public invoking this sense of wonder and connection without dragging busloads of children to excavations.

Objects in Museums – Connections Lost in Transit?

Every museum is a preselected, enclosed portion of the world. (HEIN 2000) It is a place set aside for a particular aspect of the world – art, history, natural sciences, even such singular subjects as Chinese pottery. If we take this description by philosopher Hilde S. Hein a bit further, museums could be thought of as gardens in this sense, as something representing certain aspects of the larger world outside the walls in a defined space. Just like a gardener chooses which plants and other elements to bring in and to include in her garden, museum professionals, often during several generations, decide which objects and themes should be included in a museum's collection. They decide how to catalogue them, how to arrange them within the museum, i.e. how those object could be fitted within a particular paradigm. Studying the objects and the themes they represent the museum professionals then select some of the objects according to a narrative and rearrange them into an exhibition that enables the audience to familiarize and study that particular portion or aspect of the world.

Hence museums place things in order, and collecting and managing the collections are the core functions of museums, but the collection of objects is only the beginning of their actual, practical work. The real purpose of the museums is not simply to collect, store, and display but to discover and communicate information concerning humanity's heritage, as the definition of a museum according to the International Council of Museums states:

A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purpose of education, study and enjoyment.

(ICOM 2007)

Therefore it is not enough for a museum to have objects in its possession, since not every aspect of the human heritage and its environment is an object, an artefact. Ideas, music, traditions, places, travel routes, and landscapes are also part of humanity's heritage and a fundamental part as such as they create the context in which the objects have been created, used, and discarded or replaced. From a museological point of view the value or importance of an object is determined by the story it belongs to. A spoon is merely a spoon, a thing, unless it can be tied to a history, to the larger context of the, so to speak, real world outside the museums walls. An object without a context, without a history and life, is a mute object, a loose thing adrift in the world. Such objects are not without value but their museological value is diminished since they cannot necessarily tell us much about the world. From a visitor's point of view such objects are, or they are in danger of being, pointless: mere things sitting in a display case. (Fig. 1) Such things can, of course, be beautiful and intriguing to behold, but without a story they are often mere trinkets or curiosities in the eyes of the audience. If museums are a way to bring together the ever-expanding, ever-accumulating substance of the human

experience, and to arrange and rearrange that substance to reveal new perspectives into the human condition and into the world (MÄKI-PETÄJÄ 2014), then any object and piece of knowledge included in a museum exhibition regardless of the theme must be linked, ideally, into the world outside.

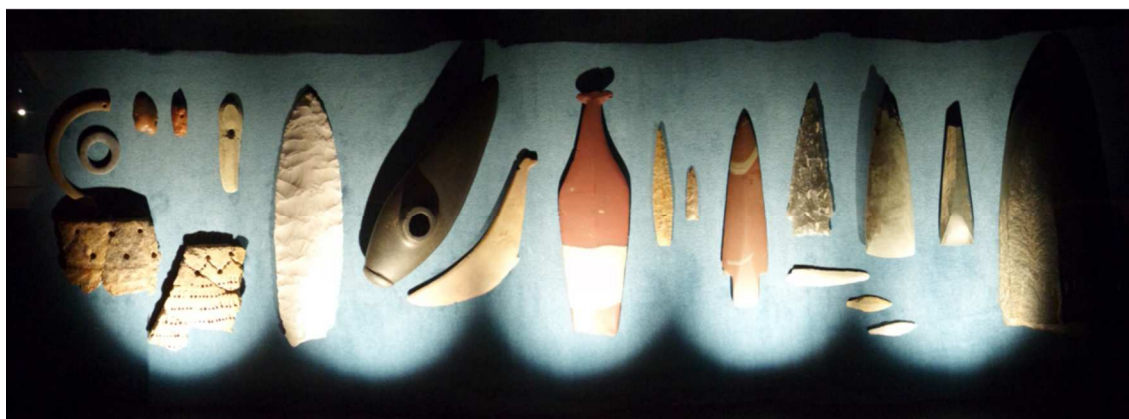


Fig. 1 – Stone age artefacts on display in the Arktikum Museum and Science Centre, Rovaniemi, Finland. (Photograph by Kaisa Mäki-Petäjä)

Some stories are easily told. Most stories, however, are more difficult to tell and, most importantly, to connect to the world outside the museum. This is especially so for objects from distant and foreign places and times because of their removedness from the average visitor's everyday experience. An average visitor looking at the stone tools in a display case (Fig. 1) will recognize their possible use by their shape but will she be able to tell much more besides how to grab them in her hand? Will she be able to relate to the Stone Age person using them? Will she be able to imagine that ancient life in its humanness at all? While we can still go to beaches of Normandy and stand there where history was made imagining the battle unfolding before our eyes, the living world and lived lives hidden in archaeological sites are more difficult to grasp. We need more assistance in picturing a full house from mere foundation stones and partial remains of a cellar even when we are standing on the spot in person. Some sites are easier to decode than others. For example the prehistoric village of Scara Brae in Orkney, Scotland, is lucky to have such clearly house-like buildings with pavement-like walkways, and stone furniture that differs only marginally from our contemporary household pieces. Conversely in Finland most prehistoric dwellings are, for an average viewer, mere dents in the landscape, almost impossible to fathom as homes (Fig. 2). Various kinds of models have always been part of a museums exhibitions but it is quite different to gaze upon a small scale model of a Mesolithic landscape than to stand and walk in the actual landscape. This is where new digital technologies can be of huge help: they can help both in connecting an object in a museum to the actual place of its origin and in bringing to life the places that have become so hidden in the contemporary landscape that they are practically indiscernible for an untrained eye. In a word, digital technologies can help a museum to give its objects a living connection with their place of origin outside the museum's walls.



Fig. 2 – Cairns, Finland. (Photograph by Kaisa Mäki-Petäjä)

From museum without walls to museums on site

Most museums have only a minute selection of their collection on display. Some may have an impressive volume of objects on display – places such as the State Hermitage Museum in St. Petersburg, Russia – but most museums are confronted with the fact that much of their collections are either hidden from the public eye in their storage or are situated outside the museum’s walls within the surrounding area or even further away in the landscape. This has left museums with two dilemmas: some objects might never see the daylight again (quite literally) and visitors may never find their way to some objects hidden outside the museum’s walls. How can we create access to collections in storage? How to guide visitors to objects and sites outside the museum?

The museum world has found a solution to these questions in André Malraux’s idea of a museum without walls. The idea was first introduced in his book, “The Psychology of Art,” published in three volumes between 1947-49, the first of which was to be later published separately as the “Museum without walls.” Malraux was concerned with art museums but his idea has found foothold in other types of museums too. The concept is compelling: a museum without walls, a museum that transcends its physical limitations and extends beyond its walls. Therefore is it not surprising that the many contemporary museums have programs under the title of “Museum without walls.” A quick internet search lists such projects as the Tufts University Art Gallery in Massachusetts, USA, where it is possible to download an application that guides its user around the campus in search of the art works in the university’s art collection. On the whole, an increasing number of museums have online collections that can be accessed online and for free, audio guides to download, and so on. Many museums have extended their public programs to social media and have taken up blogging as a way to inform their audiences about what takes place within and without the museum.

In short, museums have taken Malraux quite literally: they have tried to breach their walls and extend their presence into the world outside. They have, however, slightly missed Malraux’s original idea or at least they have gone with a different interpretation. What Malraux meant with “museum without walls” is revealed by its

original name in French, “le musée imaginaire,” the imaginary museum. This museum is not an institute but the collection of images any person carries within his/her memory. Therefore each imaginary museum is distinctive and unique. An interpretation of the world according to its keeper, one might say. It is a museum resulting from that person’s personal exploration, experiences, and imagination.

This incongruence, of course, does not mean that there is something amiss in various museums’ attempts to redefine themselves. Most of the usual interpretations of the museum without walls, however, do not transform the museum as the heart of the collection; the collection and information and knowledge concerning it are still in the museum, and it is still the museum building that is the prime objective of a museum visit. While guided walks do reveal the hidden in the landscape and allow the participating individuals to visit the actual historic sites, with the help of the full potential on mobile devices, wireless internet access, and social media the idea of the museum could be extended even further. It is now possible to move even further away from the idea of museum as a physical building with walls, ceilings, floors, basements, open exhibition halls, and closed off storages. In a word, the museum can truly be taken afield. Instead of simply having the museums contents available online, a virtual museum can be built around the actual, physical site of historical, artistic, or any other interest. There the visitor would be able to access the virtual representation of the site he/she is currently visiting, say, a prehistoric homestead or a nature reserve. The real world site would have its counterpart in the virtual space, a digital museum online where the visitor could navigate around the real site, learn about objects found there, where they were found, watch a video on how they were used, listen to the bird songs typical for the site. In the museum on site the past that lays dormant in the landscape could be revealed and animated as living history, the objects stored in the museum could be connected with their place and the life of their origin. Through augmented reality, the site would be the museum, not just an empty, forsaken set of a forgotten play the visitor is unable to reconstruct from the mere ruins (if there even are any left). In essence there would be two sites coexisting the same place, one in the real material world, the other online in the virtual realm. Both would be independent from the other, in other words, a visitor could visit only the real site or access the virtual one while at home, but visiting both simultaneously would be the museum on site.

Geolocalized Archaeological Information Systems (AIS) for museums

If we want to give objects or places their context back we need to use technology that is smarter than the usual database. While databases are well suited to give an overview of the objects stored in a museum they lack immersion and have only limited possibilities of restoring context. Another option is to turn to information systems.

The build of an information system

An information system consists of the processes used, the humans using it and the software and hardware used in the process. These are combined in a workflow to transform data into relevant information that is specific to the situation and the current needs. In the case of bringing the museum to the origins of the artefacts the Information System consist of the process, the archaeologists and museum staff, the AIS- software and the hardware used.

Theories and Procedures in the Information System

In the description of the processes that have to be taken into account the framework suggested by March and Smith (MARCH and SMITH 1995) can be adapted. The processes start with the humans who construct theories. These theories consist of constructs like concepts and models. Concepts form the vocabulary used in archaeology and museums. This language has several “dialects” which need to be taken into account, so that the data available in the constructs can later be translated into meaningful information for the user.

Models are propositions or statements expressing the relationship among concepts (Fig.3).

The theories can then be used in processes which consist of methods and their implementations. The methods used are different types of excavations, the way finds are handled or the concepts of displaying the finds in a museum. We evaluate, filter and convert the data that we are gathering based on the theories we have about the useful information contained in them even in the simple process of documenting the colour of the sediment in a posthole with the Munsell colour system.

Human interaction with the Information system

The humans that interact with the AIS are archaeologists, museum staff and the user from the public who searches for his history. In creating the output of the AIS it is important to take into account the different background of the users. This is not limited to the division between academic users and non-academic users but has to differentiate between academic users from different fields and also between non-academic users with various backgrounds. An 8 year old child on a school trip needs a different experience than a 30 year old with a long interest in history.

The external software

The software used in this scenario is the Inari AIS, which is designed as an information system with interfaces and compatibility to hardware and different software. The AIS has several layers which give the possibility to filter the data into tailored information for the user and also enable functions that allow the AIS to act as a social actor in the feedback loop between the user and the data. It can also include and make available GIS-Data, CAD-files audio- and visual data or 3D-Models. Most interesting for this purpose is the ability to get a localized first person view with a tablet, which allows the generation and exploration of virtual environments and augmented reality.

The Hardware

The hardware consists of all one hand of the devices used for documenting such as photo- and video cameras, laserscanners, total stations, GPS-devices and laptops and on the other hand of the devices the user has available, such as tablets and smartphones.

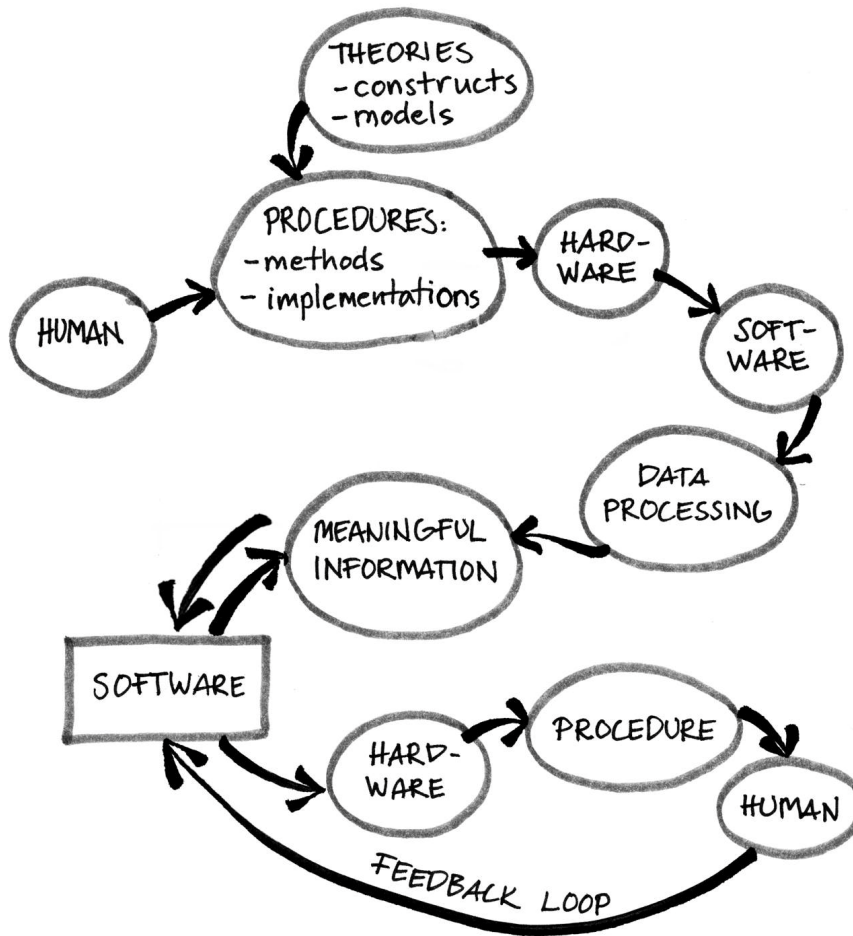


Fig. 3 – Archaeological information system (Graph by Kaisa Mäki-Petäjä)

The workflow of the Information System

The data a museum has about a site can be put together in an augmented reality that is then presented to the user through the hardware through which he in turn can interact with the system.

There are several factors which can influence the information he sees. For example his location, the time of the year, weather and controlled factors like a purchased ticket from a museum that has a QR-code that the user can scan to get access to more information.

To properly display the augmented reality a 3D- model with textures or at least a wireframe model has to be generated. The model can be animated to display for example people walking around. Special points of interest can be accessed by tapping on dots or objects that can be illuminated to show that they have more functions. They can give more information such as videos or audio or act as a tool for a more extensive search for a certain type of finds or a certain period in time. Through the first person viewer the user can experience the real height of an ancient building or see the world as it was at a certain moment in history, and he can interact with the software to change the parameters and the information he receives for example with a time slider which allows him to see how the environment developed over time.

Museum-caching - combining the game of geocaching with history

These functions mentioned above provide a good base for putting the objects back into context and to display the finds otherwise hidden in the depths of storage, but if we want people to be more interested in their history and make visits to on-site museums, a special experience with more depth is needed. We need to find a way to make visitors engaged actors instead of passive consumers.

Evoking the feeling of discovery through gamification

The answer lies in providing the information with an additional layer of gamification for example through a geocaching-like system. In geocaching small caches are hidden and their coordinates are published on a website. Often there is a puzzle that must be solved before the cache can be found. At the physical cache there is often a logbook and small items which can be exchanged. This process of gamification through adding museum-caches adds immersion to the user-experience. Instead of just looking up facts or pictures from a database the user enters a story where his actions have an impact and new mysteries wait to be unravelled. The caches depend on the basic need in humans to explore and to compete. Wherever people share a common interest they socialize, discover together and compete more or less playfully. This development has happened naturally in the geocaching community and is used in games such as Ingress where certain locations can be geotagged and areas conquered by teams. Even though the game and the areas are purely virtual with no connection to the real world other than the need to be at the right place in order to tag it, the game has been a huge success. The exploring, research and on-site discovery of geocaching can be used to help users achieve the same feeling of discovery and connection to history as archaeologists have.

The ideal state of the museum-caching would be a large community as in geocaching and the content should be created with the community and social interaction in mind. The Information System allows users at the same site to interact for example through content where each member of a group can solve part of a puzzle or where they can compete against each other. To help the users get started the AIS can also be a social actor providing cues to create a connection to the history of a site or a mystery hunt where puzzles have to be solved to gain more knowledge about a place and the objects related to it.

The five types of social cues as outlined by Fogg (FOGG 2002) are physical, psychological, language, social dynamics and social roles. These can be added in the final layer of the AIS-software in the interface that provides the user with the possibility of interaction. Having an avatar with which the user can interact and which is not static but evolves as new places are found, connects the user with his museum-caching account and can also be used on a platform where people explore these museums on site. The avatar can take the background of the user into account and take on different social roles from teammate to guide or pet. Through the language used in the interaction social dynamics can evolve and psychological cues can help in the storytelling to confer the story behind the site or object.



Fig. 4 – Museum-cache at the cairns as seen through a smartphone, Finland. (Photograph by Kaisa Mäki-Petäjä, editing by Nadja Suvi Tuulia Debenjak)

The cache

What would a museum-caching spot then look like? It can be purely virtual, visible only in augmented reality, in this case the user can spot it only by looking through a smartphone or tablet. This kind of geo-marker is especially great for places where it is difficult or simply not possible to attach information physically. They can be used where a placement with an accuracy of 1m - 2m is sufficient for information on buildings, excavation sites or information about the landscape (Fig.4).

The cache can also be just a marker with an additional description what the marker is and how to view the information behind it. This sort of physical marker is great for areas with very poor connection or where a 3D-model needs to be placed very accurately. If the marker is viewed through a smartphone or tablet the information connected to it is shown. This especially great for 3D-models with which the users can also take pictures in which it looks as if the 3D-model is standing right next to them like a physical model.

A museum-cache could even have a physical component like a box with treasures to exchange and maybe some finds which are integrated in the box so that they can't be removed. In places where there is a multitude of finds it offers the possibility to show some on site with context and information.

The content

The content of a museum-cache can be simply text or media from pictures and audio to 360°videos and 3D-models. The content can also be interactive, which gives the museum the ability to create stories which lead the user for example around a castle or excavation site highlighting certain finds or points of interest. It is also possible to create tests which could be used for example by schools to teach children something about local history. A timeslider can show content related to each period.

The museum is free to choose how to use the options given and create the content they like. The museum-caching system encourages even cooperation between several museums where a cache could be related to different aspects like technology, archaeology or biology. A cache at a castle can offer information about

medieval technology provided by one museum and pictures of the daily life in the castle provided by another. Extra points for the highscore can be awarded for the puzzle-solving or unlocking hidden content by visiting a museum or a special place or even for taking and uploading a photo of the site which gives the museum the possibility check on the site without visiting it or choosing good pictures for advertising. Because the museum-caching system is based on an information system users can also get personalized invites to exhibitions or tips on other caches which could interest them.

Conclusion –Benefits for museums and archaeology

Using the technology described here would help, first, to bring a wider scope of information available for the visitor. A traditional museum exhibition can contain only so much information without becoming overrun by it. There are limits to how much text, pictures, audio and video, and computer based information kiosks can be included into an exhibition space without turning it visually and bodily claustrophobic. Some editing must always be done but it is difficult to decide what to leave out as it means that the exhibition designers have to assume what the visitor will find interesting. In a virtual on site museum a far greater amount of information can be accessible as the spatial constraints of the museum space have been eliminated. It would also be relatively simple to create connections between different topics, objects, and sites by linking them through the system thus promoting the interconnected nature of the world. Also, using these kind of systems would mean that changing and updating the exhibition would be more straightforward. New information can be added with less hassle as it becomes available.

Secondly, the visitor would be more in control of his/her experience. This is a quest that has occupied museum professionals: how to give the visitor more freedom with the museum? How to give the visitor a chance to make the visit personally meaningful? How to take into account each visitor as an individual, to meet every visitor on his/her own terms? The museum on site would offer new solutions. A larger selection of information and modes of representation would be available and each visitor would thus be able to personalize the visit according to his/her interest and mood. A visual learner would be able to concentrate on videos and images, an auditory learner would prefer audio resources. All in all, it would be easier to accommodate to the needs of different age groups, levels of interest, and for special needs. Thirdly and in connection to the second point, it would be possible and, more importantly, less complicated to promote the visitors' active participation in museum work. The visitors could be given access to add their own images, videos, comments, and reactions to the museum on site. This would allow a more active and constructive mode of meaning making: the visitor would be able to leave his/her mark on the exhibition, something that is not easy to achieve nor allow in a traditional museum exhibition. The museum on site can also include comments and stories from the researchers and scientist that work and have worked on the site in question thus bringing the academic and the public closer to each other. The professionals would be given a chance to share their interest and enthusiasm, and the public would be able to see the site through the eyes of an expert on a more informal level, perhaps even ask questions or converse with the experts.

Museum exhibition are stories, narratives about the given subject. Previously the plot was devised by the museum and the experts alone and the visitor was merely a fairly passive audience. A museum on site would turn the visitor into a storyteller. The elements of the story would be provided by the museum and the experts but the visitor would then create his/her own narrative from those elements. One would tell a story of besieged

castle, another of the ordinary life or the learned men of the day. The narrative could be different every time a visitor visits the site and the museum on site. The site could therefore become a place of repeated visits which would help the place become more meaningful and significant for the visitor (see. TUAN 1977). This would, hopefully, promote in the visitor a more connected attitude towards his/her surroundings and a more insightful view of the world at large.

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