USE OF WIKI SYSTEMS IN ARCHAEOLOGY
Privacy, Security and Data Protection as Key Problems

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Abstract: Wikis are powerful, collaborative tools and can be used for educational purposes in many ways. The original idea of a Wiki is to make information accessible to all. However, it is very interesting that experiences in the use of Wikis in educational settings showed that security and data protection of wiki contents is definitely an issue. In this paper, we discuss problems and solutions on the basis of use cases from archaeological education. Interestingly, archaeologists are extremely worried about online accessible information due to the serious danger of archaeological looting. "Tomb raiders", i.e. people who excavate artefacts of cultural heritage on the basis of information stored in Geowikis, so called archaeological looters, are not aware of the value of cultural heritage, are interested only in the artefacts and destroying the cultural context, which is of enormous interest for archaeological research. Consequently, the protection of archaeological information is one of the most urgent tasks in the preservation of cultural heritage.

1 INTRODUCTION

Wikis are a Web technology for mass collaborative authoring, offering the asset of free and easy access for end users: everybody can contribute, comment and edit (Gorman, 2005), (Ebner, Kickmeier-Rust & Holzinger, 2008). However, during the discussion after a talk at the conference Archaeology & Computers in Vienna 2009 (Holzinger et al., 2009), it was very interesting that security and data protection of wiki contents is definitely an issue, from the perspective of archaeologists – though neglected by computer scientists. A look into the field of Archaeology makes this obviously evident:

The archaeological heritage is under serious threat from illegal and destructive excavations (archaeological looting) aiming at recovering antiquities for sale on the international market (Brodie & Renfrew, 2005).

2 BACKGROUND

Year by year, thousands of archaeological monuments are destroyed by building projects but also by archaeological looters. In fact, looting is one of the most serious problems in the protection of archaeological heritage. Metal detecting, digging without permission, non reporting of finds and selling illegally excavated objects are forbidden in many countries and – which people are often unaware – are punished severely. A famous example is the looting of several bronze weapons and a 30 cm diameter bronze disk with gold inlays, later known as the sky disk of Nebra with metal detectors on the Mittelberg near Leipzig in Saxony-Anhalt (Germany) in 1999. The disk, a unique object of the 16th century B.C. which is adorned with astral symbols, turned up at the market in 2001, subsequently confiscated by police in 2002, and is

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now exhibited in the Prehistoric Museum of Halle/Saale (Meller, 2004).

Looters are fanatical collectors driven by financial motivation or just the ecstasy of finding objects. Looters are mostly interested in metal objects, which can be easily located by metal detectors (Connor & Scott, 1998). By digging up and pulling out the objects, they destroy the archaeological context and thus the possibility to date and interpret the find. Even when these objects are located on the market or in private collections, the damage is irreparable.

Basically, looters do not rely (only) on online information; however, looters are often supported by official find reports that are nowadays widely published in electronic media. These reports offer descriptions and maps of find places and thus make the localization of the monuments very easy.

3 MATERIALS & METHODS

At Graz University of Technology several studies were carried out on how Wiki-systems could be used for different purposes (Ebner, Zechner & Holzinger, 2006), (Ebner & Walder, 2007). In subjects including Civil Engineering, Architecture, Geology, Archaeology, etc. the use of GeoWikis can be of great benefit (Priedhorsky & Terveen, 2008).

Such GeoWiki implementations are focussed on the geographical aspect and are basically implemented as editable maps. Due to specific requirements of the subjects mentioned above, a special GeoWiki, the so called TUGeoWiki has been developed (Safran et al., 2009a), which focuses on the description of the individual locations and the connections between them. The design of the TUGeoWiki server-side and client-side application was based on four central requirements: Geotagging Interface, Mobile and Desktop Interface, Collaborative Environment and Map Mashup (Auinger et al., 2009). The final requirement was to provide the integration of external location-based material, based on the coordinates available for location articles in the TUGeoWiki. This enables the integration of highly detailed material from external sources without the need to provide such material within the TUGeoWiki itself (the mashup concept). The most obvious use for a mashup in the TUGeoWiki's case is the integration of mapping material using an API, such as the Google Maps API. Numerous other map APIs are available and the integration of further material, such as geological data, could also be considered. The final application consists of two independent systems that fulfil the requirements detailed above. Most of the interaction is performed using a ediawiki, with specially developed extensions within a mobile and/or desktop browser. In order to make this extended functionality available on a mobile device in the field, additional mobile clients for the most common platforms were implemented. On the client side, all of the interaction is done with a browser, which connects to a Mediawiki on the TUGeoWiki server. The original Mediawiki is extended by two special pages. The first offers a list of all geotagged articles in the Wiki. More specifically, this page implements the functionality for the creation of new locations based on geographical coordinates. The second special page supports the upload of images including geographical coordinates. Within JPEG images, additional information can be stored in a so-called EXIF header. Besides metadata regarding a broad range of standard information such as date, time, or camera model, the EXIF header may also contain the geographical coordinates of the image. This information can either be added by a camera, when a photo is taken, or added manually at a later date. The server-side Mediawiki is further extended by a *template,* which is applied to all newly created location articles. The template contains a Google map of the area around its coordinates and it links to the corresponding location on Google Maps and Microsoft Live Maps. Moreover, the template links to another Mediawiki extension called *GeoHack,* which constructs links to various geographical services for the coordinates (Safran, Garcia-Barrios & Ebner, 2009b). Finally, all location articles are added to a common *category*.

4 USE CASES

A recent use case was the Zeğreg Tepe in the territory of ancient Tavium in Asia Minor, a hill where a famous Hellenistic and Roman sanctuary of Zeus Tavianos is supposed to have been located (Strobel & Gerber, 2000), (Koiner, Lohner-Urban & Scherrer, 2010). There was a colossal bronze statue of Zeus, and the sanctuary was known for its asylum, i.e. the protection of people who were persecuted. This sanctuary probably was built on a Hittite temple of Teššub, the Hurritian and Hittite, the weather god who was one of the predecessors of the Greek Zeus. The Zeğreg Tepe is a hill with steep flanks in the south, west and east and a more gentle slope in the north, where the main entrance is to be supposed to be located. The top of the hill is flat

with some pronounced terraces to the south and east. Surveying and air photographs located remains of walls but also rocky structures. Restricting access to these data is mandatory.

5 SOLUTIONS

Restricting access to any information and controlling the use of it are basic security requirements usually implanted in a process referred to as AAA: Authentication, Authorization and Auditing (Weippl, 2005).

Authentication. While there are three basic forms of authentication ("What you are", "What you have", "What you know"), it is mostly passwords, passphrases or similar concepts that are used in Web based applications. The major drawback is that end users tend to select very weak passwords. If combined with a token or certificate ("what you have") authorization becomes more powerful. For Wikis in our specific context, client-side authentication with tokens is feasible. Users have to be given a certificate file that they install on their computer. This certificate is then used to authenticate the client to the Web server.

Authorization. Access Control mechanisms are used to enforce restrictions of authorization. Various security models for access control have been proposed in the last few decades; one can distinguish between discretionary access control (DAC) and mandatory access control (MAC) and role-based access control (RBAC).

DAC controls access to an object on the basis of an individual user's permissions and/or prohibitions. This means that it is at the discretion of an object's owner to decide who has which kind of access. In MAC, the system decides for the user how information should be classified. Changing this categorization to lower the level is commonly prohibited in the Bell LaPadula model (Bell & LaPadula, 1976); the no-write-down property guarantees confidentiality. A role is a collection of operations (on specific objects) needed for an application. Assigning access rights to subjects based on their role is called RBAC. RBAC is commonly used in database systems as it offers two main advantages. First and foremost, RBAC clearly separates "what has to be done" from "who has to do it" in that it assigns users to roles and defines permissions on roles, which in turn takes effect when users activate the corresponding role. Second, RBAC clearly distinguishes an application's object model from the subject and authorization model (Essmayr, Probst & Weippl, 2004). The object model provides a view on objects to protect (e.g., tables, columns, entities), the subject model highlights which entities are active within a system (e.g., users, processes), and the authorization model describes rules regulating access between subjects and objects and the administration thereof (Weippl, Ibrahim & Winiwarter, 2001). In Wikis with a relatively small user group, role-based access control can be effectively used on two layers. The users and roles can be defined at application level (the Wiki) and, in addition, in the database management system. The Wiki uses, for each user, their database account to connect to the database. While this certainly impacts performance as connection pooling is no longer possible, it clearly increases security. Weaknesses in the Wiki application itself cannot be used to access the database.

Auditing. Analyzing log files to determine who accessed which data is useful to establish whether the Wiki was compromised. Auditing clearly requires reliable authentication and logging mechanisms should be difficult to disable. A good approach is to have two or three levels of logging: (1) Web server logs show the requests made to the Web server. (2) Logs on the application level contain more details on which actions a user performed. However, each application action must have corresponding entry in the Web server log. (3) Logs entries can also be generated inside the database. These entries must again match log entries on the other two levels. If inconsistencies between the log files are detected then an attacker might, for instance, have gained direct access to the database. This can be detected because the database logs would show activities not recorded on the application level. Contemporary Wiki systems only support these concepts rudimentarily, making further development highly necessary.

6 CONCLUSIONS

During the last few years, Wiki systems have become a well-used tool to enable online collaborative work in education. Research has shown the positive effect they can have on the learning process. However, the issues of privacy and security have up to now been neglected in this context, though they are an important factor. A good example is the application of Wiki-based systems in the context of archaeological education. Though especially location-based applications, such as

TUGeoWiki, can enhance the learning process and working in this context, the sensitive nature of archaeological data makes privacy and security a key issue. Authentication, authorization and auditing processes have been shown to be necessary inclusions in the future development of Wiki systems in this context. In this paper, we proposed the implementation of a dual authentication for Wikis to protect information stored in archaeological Wikis. Improving authentication and authorization will enable researchers to share more information without the fear that looters will gain unauthorized access to data and abuse the data. Moreover, precautions can be taken to avoid unintentional publication of hidden data such as location information in images. Unprotected archaeological monuments are highly susceptible to destruction by looters, consequently data protection in this field is highly important.

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