Short Paper

Digital Tools for the Emergency Response to Disasters Affecting Cultural Heritage

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Introduction

While performing emergency measures for built or movable cultural heritage in case of a disaster, a potentially large amount of information is collected. This includes basic information, specific types of documentation – both analogue as well as digital –, such as notes, sketches, photographs, video, audio, plans, geo- and 3D-information, furthermore damage and risk assessments, measures applied, relocation of objects, recommendations, etc. What is more, all this data is likely to be produced in a specific (short) time span by different people and teams, often simultaneously. To prepare and plan an emergency mission, manifold types of information are useful to have in advance, such as remote sensing and GIS data, recent photographs or videos from the affected site, information on the affected built or movable heritage, and so on.

In order to be able to handle this data, smart infrastructures are needed which not only enable a project team to organize and access the data during the emergency operation – potentially without permanent access to electricity, internet, etc. –, but also to deliver it to stakeholders such as the entity or people responsible for the affected heritage (Tandon 2018, 47, pp. 62–63).

The project 'KulturGutRetter'

The German Archaeological Institute (DAI) is currently developing an emergency mechanism for cultural heritage in crisis situations called 'KulturGutRetter (KGR)' (Cultural Heritage Response Unit), together with the Federal Agency for Technical Relief (THW), the Romano-Germanic Central Museum – Leibniz Research Institute for Archaeology (RGZM) and other partners from the Archaeological Heritage Network (ArcHerNet)[1]. The intention behind it is for the expertise that exists in Germany to be concentrated in a team of experts that can act quickly in the event of a crisis to assist in stabilizing, preserving and if need be salvaging objects and buildings. In order to facilitate future rescue missions and to guarantee a consistent and efficient collection of data, KGR is working on

[1] https://www.kulturgutretter.org/en/, https://www.archernet.org/en/

systems of data collection, evaluation and processing that can be used before, during and after a disaster.

Digital Tools

There is no doubt that, by using digital tools for documenting, the output of information is well structured, controlled and readable independently from hand writing or paper documentation that is likely to be exposed to unfavourable weather conditions. But, digital tools nowadays can be so powerful that the amount of data collected can be hard to manage.

Due to these reasons there occur special challenges in the situation of an emergency rescue mission regarding the use of digital tools. The intention is to find a workflow with which, on the one hand, as much data and as precise data as possible can be obtained, but which, on the other hand, guarantees a reduction of the overall data volume. The time needed for the collection and the complexity of the tools used must be set to a minimum in order to respond to the situation of an emergency. The tasks that should be considered among others are:

- the tools should be usable with mobile devices,
- the software should be easy to learn without the need of complex training courses,
- the level of possibilities and amount to acquire data should be flexible due to the local situation,
- the tools should work also offline,
- it should be easy to perform small adaptions in the software without having a background in IT,
- the synchronisation of data should be easy and consistent, and
- different requirements of different disciplines should be recorded equally.

Since every emergency response mission is different, the flexibility of a data acquisition system is very important. The situation at the scene depends on the type of hazard (fire, flood, earthquake, etc.) and therefore also on the available infrastructure and the type of cultural heritage located there. There may have been a lot of damage to immovable cultural heritage such as building structures, or the focus may be on movable cultural heritage such as thousands of damaged objects in a museum[2]. Therefore, the digital tools used must cover all possible eventualities, and furthermore, only the actual situation on site can determine what kind of information can be collected and what tools can be used. The possibilities range from simple sketches and photos to the use of GNSS devices or UAV support, both online and offline, with sufficient power supply or not – all leading to different types of data.

Still, there are a few basic features that should be applicable with every digital approach to emergency response measures for cultural heritage[3].

[2] For the documentation of architectural structures see for example Rieffel and Ballouz (2020).

[3] This can be seen also in other, similar projects, see for example Arches Collector (https://www.archesproject.org/collector), ODK (https://getodk.org/) or Amal (https://www.amal.global/).

A minimum standard is usually the recording of spatial data. This can be done by preparing drawings, using GPS-information or simply describing the situation enhanced by photographs. For cultural heritage that is relocated during a mission it is highly recommended to use a QR code or a similar system to make the objects traceable. The software used must be able to handle these techniques.

Another important issue that has to be executed quickly and accurate is the assessment of the damage that includes also the determination of the materials affected. This information is needed as basis for further actions that need to be taken for example to stabilize structures in danger. Using controlled vocabularies within a software can thus be an advantage to avoid misunderstandings during the data acquisition.

In the case that cultural heritage is moved or measures are applied (cleaning of mobile objects, stabilizing of immobile objects etc.) it is important that the data of the very first assessment is reliable and easily findable within the different teams that work on such a mission. That includes also the transfer of data to other software or machines that are used to restore objects on site.

Finally, also a handover to local authorities must be considered that complies with the legal requirements and for which the data is made available without difficulty and no specialized software is needed. Hence, all the data captured with different digital tools must be synchronised and sorted before.

Mobile Applications

In the 'KulturGutRetter' project two applications for mobile devices were chosen in order to cover the requirements described above. QField[4] will be equipped with a special data model for capturing the relevant information for the emergency scenario (see Figures 1 and 2). In addition, the mobile version of iDAI.field[5], the field research documenting system of the DAI, is under development at the moment (see Figures 3 and 4). The combination of both apps will provide the full flexibility and the quality of data needed to support the rescue of cultural heritage.

One of most important requirements of the apps is the flexibility of the use in different situations and the case-related conditions on site. The software must be able to acquire only a minimal set of data in the case that it won't be possible to set up a local network, or the local forces or the team of experts cannot enter the destroyed area safely etc. In the case of better conditions, the apps should be able to process even more data that can also be enriched by the use, for example, of UAVs or laser scanners. The apps also need to guide people without expert knowledge of cultural heritage through the process of reliable data acquisition. In any case, certain minimal standards need to be fulfilled.

[4] https://qfield.org/

[5] https://field.idai.world/download



Fig. 1 The use of QField for documenting damaged building structures. (© Authors).

The software environment of iDAI.field already covers most of the necessities that are needed for stabilization, salvage and further handling of cultural heritage, although it is being developed with a focus on archaeological field projects. Some added functionalities like the use of QR codes or the live synchronization between mobile devices will complement the possibility to freely create the data model in order to satisfy the needs of the different disciplines and experts that join in a KGR mission. Since iDAI.field is also in use in 'regular' research projects there is a wide spectrum of user feedback to further improve the software and the use in an emergency will already be familiar for some people, which is an advantage.

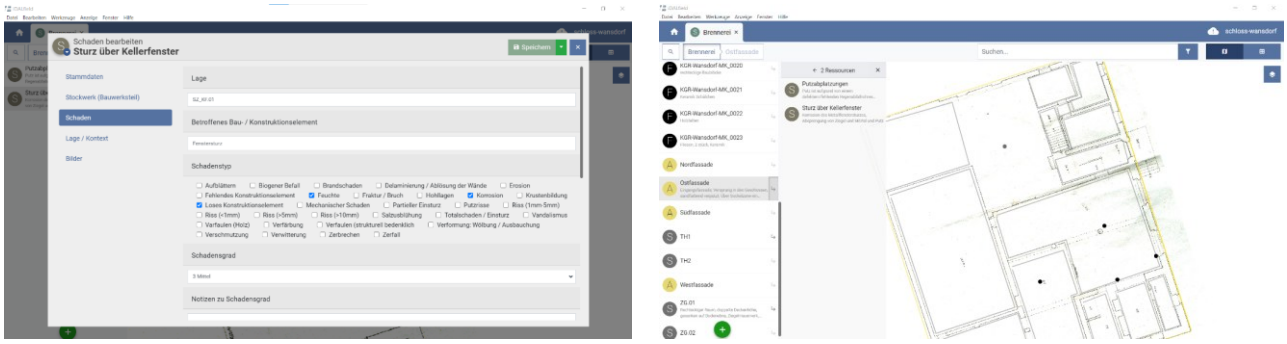


Fig. 2 Damage assessment in iDAI.field. (© Authors).

Conclusion

Since time is crucial factor in the case of an emergency, it can happen that the documentation of cultural heritage after a disaster already starts before the KGR team is at the site. This very first information can be of very high value for the assessment of the situation and can be the basis for the following work. These data can be acquired with other digital tools than the ones provided from KGR or simply with drawings and handwriting. Consequently, this data needs to be imported in the documentation workflow of KGR or other initiatives working at the site. Therefore, the use of open data formats and open source software is essential for mission success.

All data collected during a KGR mission naturally belong to the country or institution affected. The data must be easily exported from the devices and handed over in a readable and usable format. Such a data package, consisting not only of data from the mobile devices, but also 3D scans, photographs, restoration processes, or other assessments made in the field, will then hopefully help to further support the mid- and long-term safeguarding of cultural heritage. The use of uniform Minimal Standard Procedures is necessary to preserve the data in a valuable and long-term manner for all. The KulturGutRetter hope that these Minimal Standards, which will form the basis for the use of the

mobile applications, will be developed in the near future in collaboration with all partners or institutions interested in rescuing cultural heritage in emergencies.

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