

Open-access web mapping as a virtual survey tool for cultural heritage: an application to the Armenian religious architecture documented by Paolo Cuneo

Current state of conservation of cultural heritage plays a key role in the safeguard process, especially in the case of assets exposed to natural hazards including earthquakes. National and International guidelines and many studies recommend interdisciplinary methods, which can exploit the tools offered by the world of the Information and Communication Technology (ICT). The latter is largely employed in the case of the cultural heritage valorisation and virtual fruition by a large audience, but recent emergencies induced by natural hazards empowered a renewed approach to the condition assessment and monitoring of architectural and artistic assets. On the other hand, a large amount of information is available on the world wide web and many open access web mapping platforms are very effective in providing graphical and visual representation of urbanised areas.

In the present paper, the use of web-based tools

and platforms is investigated and evaluated from the perspective of selected users, namely restorer architects and structural engineers, whose skills and competences need to be integrated for a safe and reliable risk management of historical and architectural assets. The investigation is inspired by the experience of Paolo Cuneo and his contribution to the documentation of the Middle East architectural culture and aims at extending and transferring to the modern times his lessons. Herein, the attention is focussed on the Monastery of Haghpat, North Armenia, whose main characteristics are briefly recalled along with the outcomes of the virtual survey and its features.



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Keywords:
Heritage interpretation; Preventive conservation; Documentation; Condition assessment; Virtual survey.

INTRODUCTION

The preservation of the cultural heritage cannot be effectively and safely implemented in the absence of a detailed characterization of the state of conservation, especially when it is exposed to significant natural hazards, including the seismic one. The problem is extensively analysed in the technical and scientific literature (Lourenço, 2006; Masciotta et al., 2016; Ramos et al., 2018) and it is also addressed in several National and International recommendations (ICOMOS, 1996; Direttiva PCM 2011) with the aim of supporting proper preventive action and mitigating the risks. In recent years, multidisciplinary methodologies taking advantage of application of new technologies and techniques were also proposed (Mezzino et al., 2017; Reina Ortiz et al., 2019; Marra et al., 2019). It is well-known that the constructive peculiarities of architectural heritage often related to its complex development and constructive history, require an approach to the condition assessment of architectural assets similar to the one used in medicine: anamnesis, diagnosis, therapy and control (Van Balen, 2015). These different but mutually interrelated phases deliver the comprehension of the historical heritage in all its features, so that the different problems related to its restoration and its defence from environmental hazards can be solved with high accuracy.

Data and information on history, material and construction techniques are commonly collected by means of bibliographic and iconographic analysis as well as through the direct observation of the construction. Consequently, inhomogeneous data are to be managed; different and interacting informative layers exist, so that only an effective and rational analysis may provide the correlation between causes and effects of degradation and damage and thus guide in the definition of the main technological and structural issues of the asset. This is a key phase of the process, since the interpretation and analysis of the constructions drives the design of countermeasures and interventions aimed at mitigating degradation phenomena, upgrading static and dynamic per-

formance and guide the installation and management of health monitoring systems.

In last years, new technologies have significantly changed the way of approaching to cultural heritage providing a useful support in the process of knowledge and valorisation of cultural heritage (Colace et al., 2015; Trizio et al., 2019; Litvak and Kuflik, 2020).

Large availability of data on the world wide web, open-access platform and digital archives enable the dissemination of the results, making them available to a wide community, not always specialized, and promoting the understanding of the conservation state of artefacts and the development of observed degradation phenomena.

The integration between traditional and innovative approaches with the advanced technologies brings huge advantages to the area of the cultural heritage. In particular, the three-dimensional modelling of architectural complexes can be dynamically related both to digitalized information collected during the knowledge process and to data derived from monitoring systems, resulting in assisted identification of measures aimed at minimizing the risk of loss related to natural and manmade events. The management of historical heritage would become more efficient and economic, since the authorities having in charge of protection could intervene at the right time with actions that guarantee the best result with minimum impact (Marra et al., 2019).

In the present paper, the use of web-based tools and platforms is investigated and evaluated from the perspective of selected users, namely restorer architects and structural engineers, whose skills and competences need to be integrated for a safe and reliable risk management of historical and architectural assets. The investigation is inspired by the experience of Paolo Cuneo and by his outstanding contribution to the documentation of the Middle East architectural culture and can be regarded as an extension and transfer of his experience to the modern times.

Herein, the attention is focussed on the Monastery of Haghpate (Cuneo, 1996; UNESCO, 2019), North Armenia, whose main characteristics are briefly

recalled along with the outcomes of the virtual survey and its features. The aim of the study is the definition of a standardization of the quality, technical characteristics of information available online and of the approach to their processing with the aim of providing basic information on the assets of interest and even additional data to be included in condition monitoring systems able to efficiently reduce the risk of loss of these valuable evidences of the past (Kerr 2013; Doumas, 2013; Marra et al., 2019).

CROWDSOURCING AND DOCUMENTATION OF CULTURAL HERITAGE

The conservation of historical heritage, as above mentioned, is a complex task due to the several features to be considered and the different activities to be implemented in order to obtain an exhaustive knowledge of artefact. The phase of on-site survey, such as the diagnostics, are crucial both for the knowledge of the artwork and its state of conservation and for the design of safeguard measures. This is a time consuming and often requires extensive investments by National and Regional authorities having in charge the preservation of historical assets. This circumstance largely affects the reaction of owners in regenerating and upgrading their knowledge about a large number of cultural artefacts. However, nowadays opportunities generated in this field by ICT are really attractive and can fill the gap of knowledge by defining preliminary, but detailed enough and reliable, surveys based on the information available on web and derived from photos shared from people online on blog, social networks, but also on open access web-mapping platforms. Therefore, the knowledge and conservation process of cultural heritage is obtained through the engagement of community, taking the advantages of crowdsourcing systems (Oomen and Aroyo, 2011).

The word crowdsourcing is used to identify those processes aimed at obtaining services, ideas and content, or at solving problems, taking advantage of the community support. The community provides its aid both sharing different type of in-

formation through smartphone or other portable devices and interacting directly with data already available on platforms or others (Doan, Ramakrishnan and Halevy, 2011; Faggiani et al., 2014). The advantages in the use of crowdsourcing systems in the cultural heritage fields are numerous and diverse. First, the engagement of community produces knowledge on cultural heritage, facilitating new forms of dissemination and communication (Delnevo et al., 2018). Several institutions have already identified new ways of engaging people to assist in the selection, cataloguing and updating of digital contents of libraries, archives and museums, reducing the costs related to this process and, at the same time, promoting community engagement in the conservation domain (Oomen and Aroyo, 2011; Bonacchi et al., 2019). Furthermore, other studies have demonstrated the effectiveness of crowdsourcing systems in the survey and in the assessment of conservation state of cultural heritage (Dhonju et al., 2018; Ch'ng et al., 2019; Psomadaki et al., 2019). D'Angelo, Riccardi and Gugliermetti (2018) carried out a photogrammetric survey starting from photos taken with a non-professional camera, in order to study the limit of three-dimensional reconstruction proper of crowdsourcing systems. Stathopoulou et al. (2015) and Wang et al. (2019) suggest the implementation of an open web platform enabling users to upload photos of some assets of cultural heritage. In particular, data collected are processed: i) to realize the three-dimensional model of a stone bridge of Plaka (Stathopoulou et al., 2015); ii) to obtain information concerning the conservation state, through deep learning algorithms, of Great Wall heritage (Wang et al., 2019).

However, the management and safeguard processes by the appointed authorities could be supported by the collecting, validating and cataloguing the information made available by the community on blogs, social networks, or open access web-mapping tools. Among the latter, Google Maps platform allows not only to geolocalize the asset of interest but also offers even panoramic views, taken at 360° horizontally and 160° vertically along the streets and recorded by vehi-

cles equipped with camera, and images uploaded in the platform by logged users.

This platform represents a huge database in which the data, if properly reviewed and ordered in time, can provide useful information related to typological and constructive characteristic as well as to state of conservation and degradation, as well as support the virtual modelling creation. Moreover, it is worth noting that the data acquisition phase in the conservation process requires the integration of different and inhomogeneous sources, primarily those associated to archival and iconographic documentation, in order to accomplish the task of defining a validated holistic view of the artefact able to provide a reliable constructional history and the evolution in time of degradation and damage due to environmental and human actions. It is therefore clear that the development of a complex process, which can take advantage of interactive virtual models connected to a database of bibliographic data, photos collected online or in situ, information concerning materials, construction techniques and conservation state would make the conservation and management process of cultural heritage more effective. Indeed, the time required to define the actions to be implemented would be reduced since the authorities having in charge of protection would be able to act directly within the information system, based on a common and shared knowledge and a unique vision of the asset of interest (Marra et al., 2019).

A VIRTUAL SURVEY IN THE PLACES OF PAOLO CUNEO: THE MONASTERY OF HAGHPAT

The interests in Armenian's politic, cultural and architectural history are the central focus of researches and studies carried out by Paolo Cuneo since 1965. The researches and excavation activities carried out together with Armen Zarian, Tommaso Fratadocchi Breccia, Francesco Gandolfo and Adriano Alpago-Novello, led him to define a novel methodology aimed at identify from single building useful information to compare architectural types and chronological phases. Cuneo identified the main features of Armenian architectural

identity through detailed researches and analysis on religious building located in the country, whose information was collected in proper forms enriched by graphic tables, photographic and bibliographic documents. "Paolo Cuneo had an overall political and cultural vision of the area, and never disjoined the analysis of the architectural event from social context [...]. The development process of religious architecture is outlined on the results of previous research, through the comparisons resulting from several buildings" (Bonardi, 2014). In this constant comparison between several buildings analysed by Cuneo, with particular reference to the monumental buildings of the royal city of Ani, there is the analysis of the great complex of Haghpats, "the highest flowering of Armenian religious architecture between the 10th and 13th centuries" (ICOMOS, 1996).

The monastery of Haghpats, included in the World Heritage List since 1996, is the greatest evidence of Armenian religious architecture (Fig. 1). The monastic complex is located on a plateau in the north of Lori region in Armenia. The complex is an important example of religious settlement characterized by different architectural units, built in accordance with the architectural and constructive typologies of the 10th-13th centuries and de-

Fig. 1 - Monastery of Haghpats: general view (Photo by Heretiq - <https://en.wikipedia.org/wiki/File:Haghpats-Nshan.jpg>).



signed to host several functions (UNESCO, 2019), which give it an asymmetrical but volumetrically balanced and harmonious view perfectly integrated in the landscape. The architectural language is the result of a perfect combination of architectural elements derived from Byzantine ecclesiastical architecture with the traditional vernacular one of the Caucasian regions (ICOMOS, 1996).

Haghpat was built in the second half of 10th century by the Queen Khosrovanus, wife of Bagratid Ashot III, and was extended during the 12th-13th centuries when it became an important international centre of religious culture. The complex grew within a polygonal surrounding wall according to the principle of successive aggregation, and without a planning scheme, around the Church of St. Nshan, built by the architect Trdat between 976-991. The church is a rectangular domed construction, extended from east to west, with a cross-shaped plan and dome roof. In 1015 the St. Gregory church was built, and extended in 1211 after the construction of the Gavit of Nshan (1210) and in the same period of the Mausoleums of Ukaniants family, whose construction lasted from 1211 to 1220. During the 13th century, the bell tower (1245) and the Gavit of Hamazasp (1257) were built (Cuneo, 1996) (Fig. 2).

The most interesting buildings of the complex are the two gavits, a functional narthex used for civil and religious purpose. Generally, the gavits are square-shaped room, located in front of a church and in axis with it, covered by crossed arches on central pillars and by vaults resting on the surrounding walls (Zarian, 1996a). The central area is covered by a dome, with octagonal plan, linked by corner elements and externally covered by another structure (lantern) that lights up the space zenithally (Zarian, 1996a).

The Nshan's Gavit is different from traditional typology since it has a cross-shaped plan with free-standing nave (Fig. 2). "Most striking is its central sector, which is covered by a daring dome, square in plan and borne by two pairs of intersected arches [9], and lit from the top by a second similar structural device on a smaller scale, supporting a lantern" (Cuneo, 1996, p. 188). The Hamazasp's



Fig. 2 - Monastery of Haghpat. General plan view. (<http://www.armenica.org/cgi-bin/armenica.cgi?698337748279208=2=ba=4====baz0000====>).

gavit is the largest building in the monastic complex. A central dome, resting on four free columns that support also the cross vaults of the surrounding spaces, covers the room.

This outstanding religious centre encompasses, in addition, the hall of the great khatchkar, the church of the Virgin (St. Astvatzatzin), the library, the refectory and the kitchen, all built during the 13th century. It is worth mentioned the architecture of the bell tower [zangakatoun] built isolated in the eastern part of the complex. It is the first example of this type of construction and is characterized by its unique volumetric-spatial solution. It has a cross-shaped plan on the ground floor, an octahedral volume on the first floor and a slender lantern, resting on eight columns, on the roof level (UNESCO, 2019).

During the centuries the monastic complex has suffered several restoration and conservation works, many carried out during the 17th century, with the aim of repair the damage caused by invasions, earthquakes and degradation. Between 1939-1940, and then in 1960 and in 1980, further restoration and conservation works was carried out by the Committee for the Preservation of Monuments of the Armenian SSR (ICOMOS, 1996).

The buildings in Haghpat were made of tuff, a widespread material in the territory due to the volcanic nature of the soils and making the architectures perfectly integrated in the landscape and structural elements with creative shapes were built. The Armenian wall is characterized by two different masonry parts – inner and external – perfectly smooth and an inner layer made of mortar and materials resulting from works of the two main masonry parts (Zarian, 1996b). The masonry typology, with its monolithic structure, provides a good response to stress induced by earthquakes and can incorporate “anti-seismic devices”, such as the section of embedded stones in the bell tower of Haghpat, indeed Armenia is a region with high seismic risk (Zarian, 1996b).

Finally, it is worth noting that in the monastery of Haghpat several valuable elements, such as frescoes and sculptures that are a significant example of Armenian Christian art, are preserved (Cuneo, 1996).

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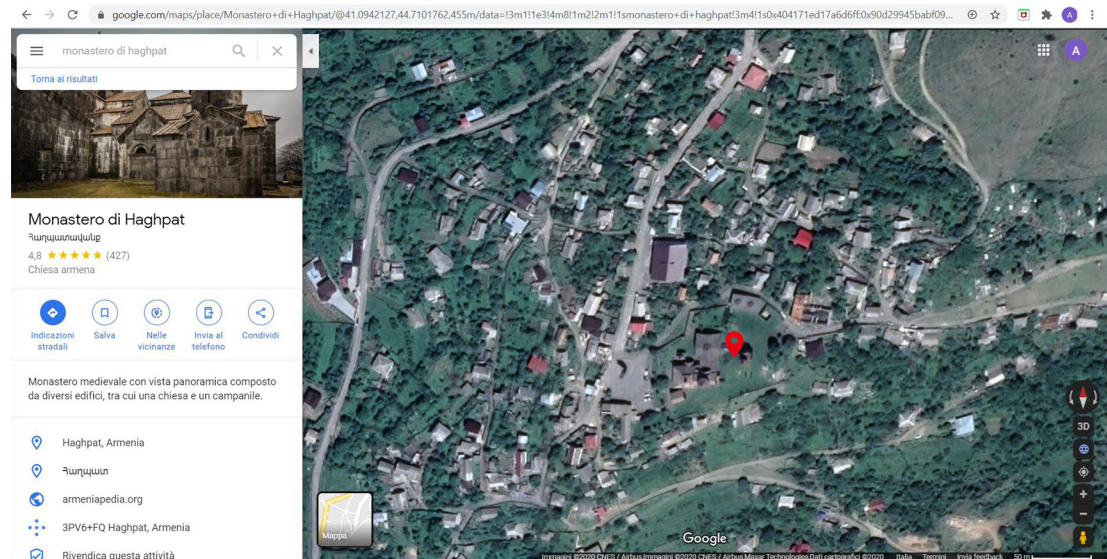


Fig. 3 - Monastery of Haghpat: location from Google Maps.

SUNDAE: A CROWD-BASED ICONOGRAPHIC CATALOGUE FOR PRESERVATION AND MAINTENANCE

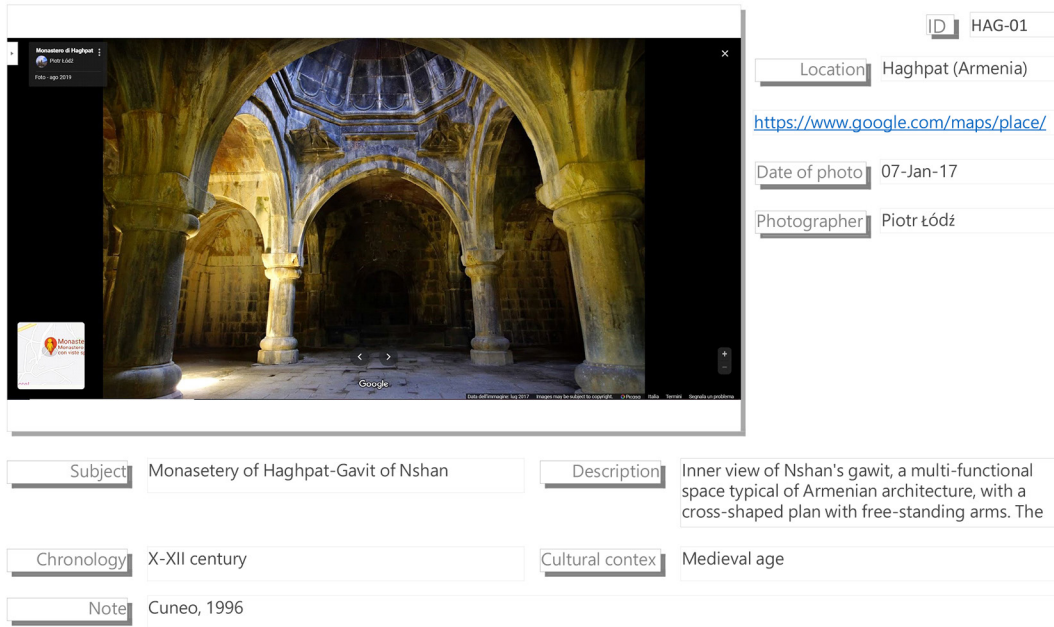
The condition and conservation assessment of the monastery of Haghpat by means of virtual tours and crowd-based iconographic analysis is briefly reported herein.

The first phase of research involved an in-depth knowledge of the artefact analysed. Information on history, construction techniques and graphical supports, including dimensional data, has been gathered from relevant scientific literature and other sources available on web, such as blogs and pages dedicated to the complex. The condition assessment of the asset has been explored by means of a virtual survey carried out by applying the crowd-sourcing paradigm illustrated in the previous sections. In this specific case, it has been found that the modern iconography offered by web platforms cover a wide time span, so that the evolution of relevant degradation and alteration phenomena can be detected and eventually

tracked over time. In order to properly collect and manage the collected digital data, a tool capable of cataloguing and supporting the analysis and the definition of the current conservation state of the artefact has been designed and implemented. The tool is deployed in the form of catalogue that facilitates the correlation and the integration of the surveys according to the information collected by means of the web-mapping platform Google Map (Fig. 3) and it is compliant with the standard developed by the Italian Central Institute for Catalogue and Documentation (ICCD); particularly compliance with the F form (photography form) has been ensured (Berardi, 2015). The F form is characterized by 79 fields, 23 simple and 56 structured in 246 sub-fields. According to the number of fields compiled, namely the number of information collected, the F form reaches three different research levels: (i) inventory level, all data that can be collected directly from a careful and analytical evaluation of the object are recorded; (ii) pre-cataloguing level, specific fields to record are

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SUNDAE Catalogue



The screenshot displays the SUNDAE catalogue form for a specific entry. On the left, there is a large image of the interior of the Monastery of Haghpat, showing a cross-shaped plan with free-standing arms. The image is a Google Street View capture, with a small 'Monastery of Haghpat' logo in the bottom left corner. To the right of the image, the form fields are populated with the following information:

- ID:** HAG-01
- Location:** Haghpat (Armenia)
- Source:** <https://www.google.com/maps/place/>
- Date of photo:** 07-Jan-17
- Photographer:** Piotr Łódź
- Subject:** Monastery of Haghpat-Gavit of Nshan
- Description:** Inner view of Nshan's gavit, a multi-functional space typical of Armenian architecture, with a cross-shaped plan with free-standing arms. The
- Chronology:** X-XII century
- Cultural context:** Medieval age
- Note:** Cuneo, 1996

Fig. 4 - Example of SUNDAE catalogue form.

identified in addition to those provided for the first level; (iii) cataloguing level, all the available fields are recorded acquiring information from specific and in-depth researches (Berardi, 2015). Therefore, the main fields of F form have been identified due to the research aim, starting from those required for the first level of recording and knowledge, inventory level. Fig. 4 shows the basic form of SURvey and coNDition AssessmEnt (SUNDAE) catalogue; it is made of 11 fields and collects relevant iconographic data made available by users of web mapping and social web-services. Each image collected from the selected crowdsourcing platform, in the current case Google Maps, is identified through a unique code (*ID*). The information concerning the specific location of the artefact showed in the photo (*Location*) and proper informa-

tion on the date of built and cultural period (*Chronology* and *Cultural context*) are also collected. For each photo, useful data to identify the subject photographed (*Subject*) and a brief description of the subject (*Description*) are provided. Finally, the form provides a specific section that includes information on the author of the photo (*Photographer*), the date of the picture (*Date of photo*) and the hyperlink to the platform from which the picture was acquired (*Source*). The images collected have been chronologically ordered to identify degradation and/or damage phenomena, to understand their evolution and, finally, to provide a critical evaluation on the conservation state of the analysed asset. The correlation between main references and images acquired outlines the transformations occurred over time and the associated materials and

construction techniques. At the same time, the number of photos and of dimensional data properly processed provides a digital model of the artefact using the techniques of Structure From Motion (SfM) (Bianchini and Russo, 2018). The quality of models and texture is dependent upon the number of images collected in the catalogue; therefore, it is possible to develop both simplified models, which describe the artefacts and can be used to manage the results of knowledge process, and detailed models, which are similar to those obtained from an in-situ survey thanks to which critical and technical assessment on structural and non-structural components could be performed. The approach, currently developed in critical manner, facilitates the knowledge process filling the existing gaps in the processes related to the protection and en-



Fig. 5 - Monastery of Haghpat: first image of crowdsourcing system in July 2008.

hancement of cultural heritage. Further developments can be oriented at achieving a certain level of automation, first of all in the area of image acquisition and processing.

SUNDAE IMPLEMENTATION AND RESULTS

The current status of the work counts a collection of about 120 photos showing several architectural units of monastery of Haghpat have been collected in the SUNDAE database. Photos with filters threatening the inspection of the real condition of the asset were discarded such as those including people or groups and, at last, those in which the real subject was the surrounding landscape,

which is not the main theme of this research. The catalogued photos were taken by 88 different users and cover a time span of about 10 years, from July 2008 (Fig. 5) to June 2020 (Fig. 6). The comparative analysis of the entire photo set tracks the development of degradation phenomena inside and outside the different buildings and, at the same time, the safeguard actions implemented to mitigate them. Based on the photos taken in the last 5 years in May, it is found a widespread presence of infesting vegetation both on the roofs and on the masonry walls, where run-off phenomena, biological patina and efflorescence can be also detected (2015-2016) (Fig. 7 and Fig. 8).

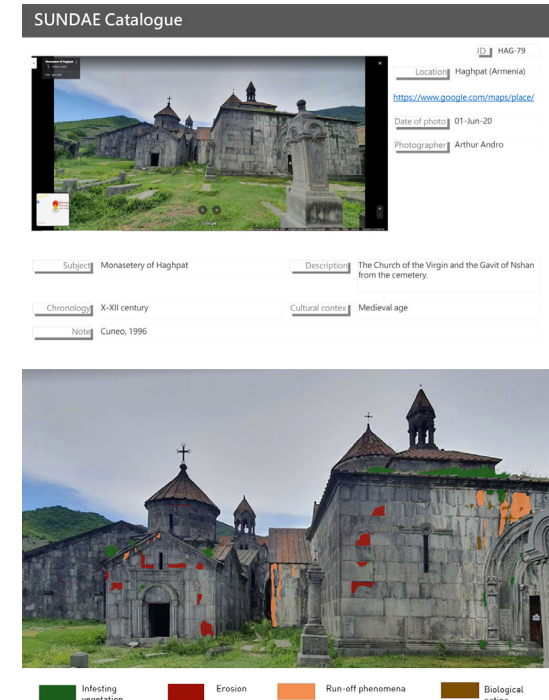
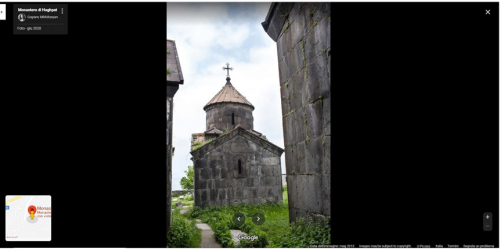


Fig. 6 - Monastery of Haghpat: last image of crowdsourcing system in June 2020 (above) and degradation forms (bottom).

In 2017, there are no significant degradation form (Fig. 9). Starting from 2018, roofs and masonry surfaces are one again covered by infesting vegetation (Fig. 10), a phenomenon that increases in 2019 and to which other degradation form, such as biological patina and efflorescence, are added (Fig. 11). In the last available photo taken in 2020, the infesting vegetation on masonry walls is not widespread and is totally absent on roofs (Fig. 12). Comparing this photo with those of the previous months, January 2020 (Fig. 13) and October 2019 (Fig. 14), it can be argued that the monastic complex have recently subjected to maintenance interventions by the authorities appointed for the conservation. Although the evidences of past damage are still

SUNDAE Catalogue



ID: HAG-51

Location: Haghpat (Armenia)

<https://www.google.com/maps/place/>

Date of photo: 01-May-15

Photographer: Gayane Mkhitarian

Subject: Monastery of Haghpat

Description: St. Astvatzatzin (Khatounashen) (Church of the Virgin) built 1208-1220, also known as the "Khatounashen" for patron Lady Khatun. The

Chronology: X-XII century

Cultural context: Medieval age

Note: Cuneo, 1996



Fig. 7 - Monastery of Haghpat: state on conservation in May 2015 (on left) and identification of degradation form (on right).


visible and erosion of surface layers on stone elements can be detected, the architectural units of the monastic complex are in good condition, probably because they are regularly maintained through proper actions.

A step forward a more comprehensive use of crowd-based information collection is made by processing the collected images with the aim of defining a three-dimensional scaled view of the assets. This is the case of the collected photos of the Church of the Virgin that have been processed through the Agisoft Metashape software. The photos have a resolution of 300 dpi, appropriately focused, without optical distortions but some were acquired from a very close to the object. It is worth noting that photos exhibit also problems related to light variations (bright sunshine, clouds, shadows, dusk light and other issues) and, therefore, proper manipulation and corrections are needed to make them suitable for the purpose.

The careful analysis and the associated correction process deliver about 45 images; the background elements have been masked during the photo alignment in order to have a dense cloud less noisy (Fig. 15). The software has not been able to process the images of side façade due to the small number of images. A mesh has also been created

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SUNDAE Catalogue



ID: HAG-17

Location: Haghpat (Armenia)

<https://www.google.com/maps/place/>

Date of photo: 01-May-16

Photographer: Adam Mike

Subject: Monastery of Haghpat

Description: External view of the monastery, with details of the surrounding walls.

Chronology: X-XII century

Cultural context: Medieval age

Note: Cuneo, 1996

Fig. 8 - Monastery of Haghpat: state on conservation in May 2016.

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from the dense cloud (Fig. 16).
The processed model, even if not fully optimized, highlights the possibilities offered by the collection of images from crowdsourcing systems in the creation of simplified three-dimensional models of cultural heritage for its preservation and valorisation.

SUNDAE Catalogue

Monastery of Haghpot

Location: Haghpot (Armenia)
<https://www.google.com/maps/place/>
Date of photo: 01-Apr-17
Photographer: Aghasi Martirosoyan

Subject: Monastery of Haghpot
Description: The Church of the Virgin - side view - and the Gavit of Nishan - side view.
Chronology: X-XII century
Cultural context: Medieval age
Note: Cuneo, 1996



Fig. 9 - Monastery of Haghpot: state on conservation in April 2017 (above) and degradation form (bottom).

Fig. 10 - Monastery of Haghpot: state on conservation in May 2018.

Fig. 11 - Monastery of Haghpot: state on conservation in May 2019 (on left) and degradation forms (on right).

SUNDAE Catalogue

Monastery of Haghpot

Location: Haghpot (Armenia)
<https://www.google.com/maps/place/>
Date of photo: 01-May-18
Photographer: Sergey Fomin

Subject: Monastery of Haghpot
Description: St. Atsvatzatzin (Khatounashen) (Church of the Virgin) built 1208-1220, also known as the "Khatunashen" for patron Lady Khatun. The
Chronology: X-XII century
Cultural context: Medieval age
Note: Cuneo, 1996

Monastery of Haghpot

Location: Haghpot (Armenia)
<https://www.google.com/maps/place/>
Date of photo: 01-May-18
Photographer: Sergey Fomin

Subject: Monastery of Haghpot
Description: St. Atsvatzatzin (Khatounashen) (Church of the Virgin) built 1208-1220, also known as the "Khatunashen" for patron Lady Khatun. The
Chronology: X-XII century
Cultural context: Medieval age
Note: Cuneo, 1996

SUNDAE Catalogue

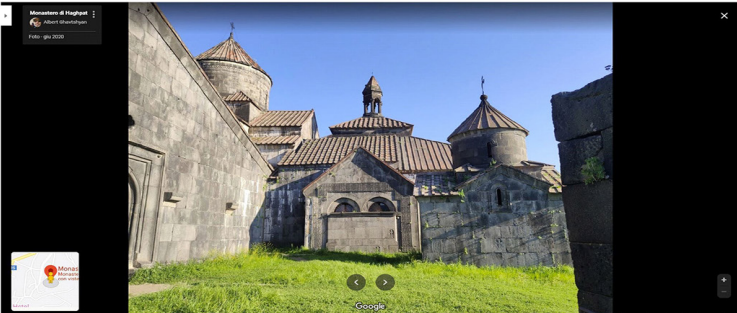
Monastery of Haghpot

Location: Haghpot (Armenia)
<https://www.google.com/maps/place/>
Date of photo: 01-May-19
Photographer: Weng Hong Leong

Subject: Monastery of Haghpot
Description: View on the Church of the Virgin from the cemetery.
Chronology: X-XII century
Cultural context: Medieval age
Note: Cuneo, 1996



SUNDAE Catalogue



ID

Location
<https://www.google.com/maps/place/>

Date of photo

Photographer

Subject


Description

Chronology

Cultural context

Note

SUNDAE Catalogue



ID

Location
<https://www.google.com/maps/place/>

Date of photo

Photographer

Subject

Description

Chronology

Cultural context

Note

DISCUSSION AND FINAL REMARKS

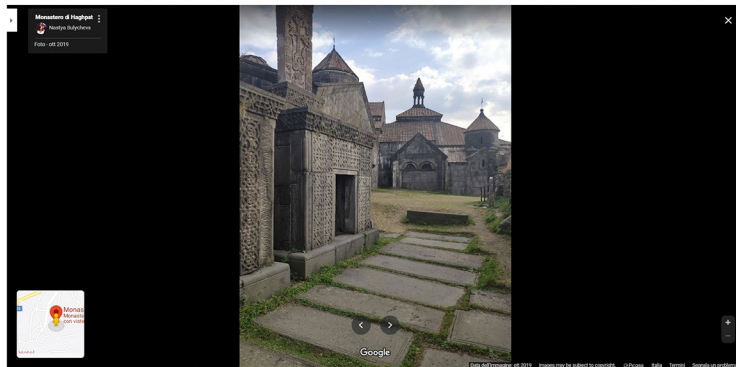
The experience of Paolo Cuneo and his outstanding contribution to the diffusion of alternative and original cultures, like the Armenian, represents a paradigm of the traditional approach to the development of the knowledge in the field of the history of architecture. It represents also an outstanding contribution to the archival and iconographic sources to be analysed in the event of technical assessments for preservation purposes, including structural interventions for protection against natural hazards. Technical guidelines at National and International levels point out the role of tests on materials, components giving priority to the non-destructive ones. In such a context, novel digital technologies represent an attractive option for the technical personnel having in charge the definition of reliable knowledge paths or the monitoring of the current conditions of the historical assets. This is particularly the case of smart devices permanently connected to the world wide web, whose capacity of capturing high quality images and of sharing them in real-time continuously increases and drives the development of the crowdsensing paradigm.

The crowd-based fast virtual SUNDAE catalogue represents an approach to the problem designed in order to fulfil the requirements of an effective and up-to-date knowledge path of historical constructions. It is not still comprehensive, since it needs to be extended to other open access web mapping platforms, social networks, blogs, etc., and primarily needs to be improved by a certain level of automation. However, the analysis of the early results confirms its capacity to fill some existing gaps in the knowledge and monitoring needed by the authorities having in charge of protection, management and enhancement of cultural heritage.

Fig. 12 - Monastery of Haghpat: state on conservation in May 2020.

Fig. 13 - Monastery of Haghpat: state on conservation in January 2020.

SUNDAE Catalogue



ID | HAG-85

Location | Haghpat (Armenia)

<https://www.google.com/maps/place/>

Date of photo | 08-Oct-19

Photographer | Nastya Bulycheva

Subject | Monastery of Haghpat

Description | View on the Gavit of Nshan and Church of the Virgin from the Ukaniants Sepulchers.

Chronology | X-XII century

Cultural context | Medieval age

Note | Cuneo, 1996

These encouraging perspectives are confirmed by the outcomes of the illustrative application to the Monastery of Haghpat and by the capacity of the methodology to provide a virtual insight on the monument fully consistent with the tradition of Paolo Cuneo and his outstanding lesson.

NOTE

The authors conceived this work jointly. Adriana Marra collected basic material, processed data and wrote the paper; Giovanni Fabbrocino supervised the research and reviewed the paper.

Fig. 14 - Monastery of Haghpat: state on conservation in October 2019.



Fig. 15- Church of the Virgin: dense point cloud (3.148.834 points).

Fig. 16 -Church of the Virgin: 3D model (629.766 faces).

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