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DiXiT Digital Scholarly Editions Initial Training Network

# AIUCD 2017 Conference
## 3rd EADH Day
## DiXiT Workshop
### "The educational impact of DSE"

**23-28 January 2017 Rome**

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# Indice

***AIUCD 2017 Conference, 3rd EADH Day, DiXiT Workshop*** *"The Educational impact of DSE"*
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# AIUCD CONFERENCE

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# Coping with interoperability in cultural heritage data infrastructures: the Europeana network of Ancient Greek and Latin Epigraphy

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## The EAGLE Project

Ancient inscriptions are a valuable source of information about otherwise undocumented historical events and past laws and customs. However, centuries of unregulated collection by individuals and by different institutions has led to an extremely fractioned situation, where items of the same period or from the same geographical area are presently scattered across several different collections, very often in different cities or countries.

One of the main motivations of the project EAGLE (Europeana network of Ancient Greek and Latin Epigraphy, a Best Practice Network partially funded by the European Commission) is to restore some unity of our past by collecting in a single repository information about the thousands of inscriptions now scattered across all Europe.

The collected information (about 1,5 million digital objects at project's end, representing approximately 80% of the total amount of classified inscriptions in the Mediterranean area) are ingested into Europeana, as they represent the origins of the European culture. That information is also made available to the scholarly community and to the general public, for research and cultural dissemination, through a user-friendly portal supporting advanced query and search capabilities (Figure 1).

In addition to the traditional search options (full text search a la Google, fielded search, faceted search and filtering), the EAGLE portal supports two applications intended to make the fruition of the epigraphic material easier and more useful.

The EAGLE Mobile Application enables a user to get information about one visible epigraph by taking a picture with a mobile device, and sending it to the EAGLE portal. The application uses a visual search engine to retrieve the photographed object from the EAGLE database and provides to the user the information associated with that object.

The Story Telling Application provides tools for an expert user (say a teacher) to assemble epigraphy-based narratives providing an introduction to themes and stories linking various inscriptions together (e.g. all the public works done by an emperor). The stories are then made available at the EAGLE portal, and are intended for the fruition of the epigraphic material by less knowledgeable users or young students.

Along the same lines, in order to make the epigraphic material more interesting and usable also by non-epigraphists, EAGLE, in collaboration with the Italian chapter of the Wikimedia Foundation, is leading an effort for the enrichment of the epigraphic images and text with additional information and translations into modern languages. This additional material, residing on Wikimedia, is periodically harvested and included in the information associated with each epigraph.

During the whole project life frame the maintainability and sustainability issues have been constantly considered from both the technical and the scientific point of view. This led to the foundation of IDEA (The International Digital Epigraphy Association, http://www.eagle-network.eu/founded-idea-the-international-digital-epigraphy-association/) whose aim is the promotion of the use of advanced methodologies in the research, study, enhancement, and publication

of “written monuments”, beginning with those of antiquity, in order to increase knowledge of them at multiple levels of expertise, from that of specialists to that of the occasional tourist. Furthermore, scope of the association is to expand and enlarge the results of EAGLE providing a sustainability model to ensure the long-term maintenance of the project results and to continue to cope with its original aims. The presentation of that activity is however outside the scope of this poster.

This poster gives some insights of the overall infrastructure. The two following sections describe respectively the core of the Aggregation Infrastructure and some key characteristics of the Image Retrieval System and the Mobile Application.

Details on the characteristics and use of the two applications and the other resources can be found at:

http://www.eagle-network.eu/resources/


Figure 1 - Searching in EAGLE.

## The EAGLE Aggregation Infrastructure

EAGLE aggregates content provided from 15 different archives from all over Europe. While most of them are providing records based on EpiDoc (an application profile of TEI, today the de-facto standard for describing inscription), some archives are supplying records in “personalized” formats. EAGLE aggregates data also from two other different sources: Mediawiki pages, containing translations of inscriptions, and “Trismegistos records”, containing information about inscriptions that appear in more than one collection.

The need for expressing queries against such heterogeneous material has led to the definition of a data model being able of relating separate concepts and objects in a seamless way, thus allowing both the scholarly research and the general public to achieve results which could hardly be obtained with the existing EpiDoc archives.

The EAGLE data model (Casarosa 2014) consists of an abstract root entity (the Main Object) from which four sub-entities can be instantiated: (i) Artefact (capturing the physical nature of an epigraphy); (ii) Inscription (capturing the textual and semantic nature of a text region possibly present on an artefact); (iii) Visual representation (capturing the information related to the “visual nature” of a generic artefact); (iv) Documental manifestation (capturing the description of an inscription’s text in its original language and its possible translations in modern languages). All the information to be aggregated in EAGLE will find its place into one or multiple instances of such sub-entities.

The EAGLE Aggregation Infrastructure is built on top of the D-NET software, developed by CNR-ISTI in the course of its participation in a number of European projects. D-NET is an open source solution specifically devised for the construction and operation of customized infrastructures for data aggregation, which provides a service-oriented framework where data infrastructures can be built in a LEGO-like approach, by selecting and properly combining the required services (Manghi 2014). For EAGLE, D-NET has been extended with image processing services to support the Mobile Application (Figure 2).

In D-NET, data processing is specified by defining workflows (i.e. a graph of elementary steps, with optional fork and join nodes) and meta-workflows (i.e. a sequence of workflows). A (meta-) workflow can be easily configured, scheduled and started through a D-NET tool with a graphical user interface, while the implementation of the elementary steps is done by writing programs actually executing the needed processing.

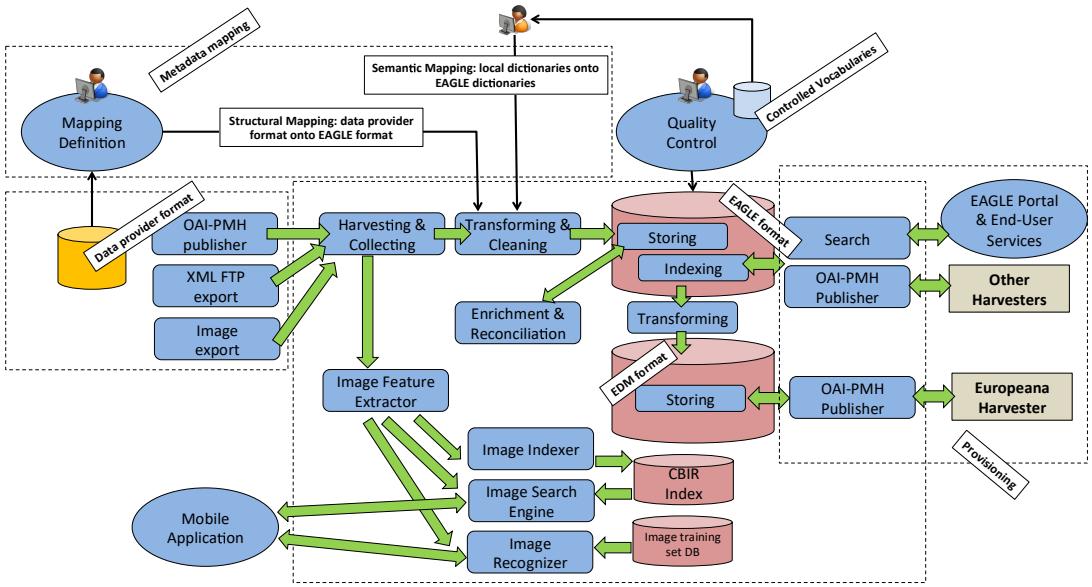


Figure 2 - The EAGLE Aggregation Infrastructure.

## The EAGLE Image Retrieval System and the Mobile Application

The EAGLE Image Retrieval System allows users (like tourists or epigraphists) to retrieve information about an inscription by simply taking a photo, e.g. by using the EAGLE Mobile Application (Figure 3), or by uploading a query image on the EAGLE Web Portal (Figure 4). This represents a profitable and user-friendly alternative to the traditional way of retrieving information from an epigraphic database, which is mainly based on submitting text queries, for example, related to the place where an item has been found or where it is currently located.

The system offers two modes to search for an image provided as input query. In the first mode, called *Similarity Search*, the result will be a list of images contained in the EAGLE database, ranked in order of visual similarity to the query image. In the second mode, called *Recognition Mode*, the result of the query will be the information associated with the recognized inscription (whenever the object depicted in the query image is present in the EAGLE database). In the recognition mode, it is possible for an epigraph to appear in any position of the query image (Figure 5), also as part of a more general picture (e.g. a photo of an archeological site, or a scanned image of a page of a book).

The image search and recognition services are based on the use of visual features, i.e. numerical representation of the visual content of the image, for comparing different images, judging their similarity, and identifying common content. The image features are inserted into a Content-Based Image Retrieval (CBIR) index that allows image search to be executed very efficiently even in presence of huge quantity of images. Examples of image features are the *local features* (e.g., SIFT and SURF), the *quantization* and/or *aggregation* of local features (e.g., BoW, VLAD, and Fisher

Vectors), and the emerging *deep features* (e.g., CNN features).

During the EAGLE project, several state-of-the-art image features had been compared in order to find the most prominent approaches to visually retrieve and recognize ancient inscriptions. An extensive experimental evaluation was conducted on 17,155 photos related to 14,560 inscriptions of the Epigraphic Database Roma (EDR) that were made available by Sapienza University of Rome, within the EAGLE project. The results on EDR, presented in (Amato 2014, Amato 2016), show that the BoW (Sivic and Zisserman, 2003) and the VLAD (Jégou 2010) approaches are outperformed by both Fisher Vectors (Perronnin and Dance 2007) and Convolutional Neural Network (CNN) features (Donahue 2013) for visual retrieving ancient inscriptions. More interestingly, the combination of Fisher Vectors and CNN features into a single image representation achieved a very high effectiveness: the query inscriptions were correctly recognized in more than 90% of the cases.

Typically, the visual descriptors extracted from images have to be inserted into a CBIR index to efficiently execute the retrieval and recognition process. The EAGLE image indexer uses the functionality of the *Melampo CBIR System*. Melampo stands for *Multimedia enhancement for Lucene to advanced metric pivOting*. It is an open source CBIR library developed by CNR-ISTI, which allows efficient searching of images by encoding image features into strings of text suitable to be indexed and searched by a standard full-text search engine. In this way, the mature technology of the text search engines is exploited.

As trade-off between efficiency and effectiveness, in the EAGLE Mobile Application, the deep CNNs features have been selected and used as image features for the similarity search mode, while the VLAD has been used for the recognition functionality. Currently, more than 1.1 million epigraphs and inscriptions are visually recognizable.


Figure 3 - The EAGLE Mobile Application, which is available for download on Google Play Store, allows users to get information on a visible inscription by simply taking a picture from a mobile device.

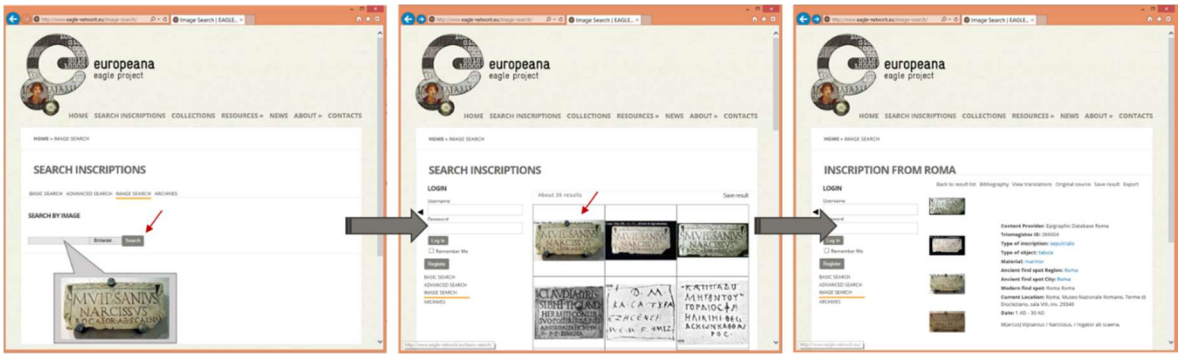


Figure 4 - Example of image search functionality in the EAGLE Web Portal (http://www.eagle-network.eu/image-search/). Given a query image, the system retrieves the most visually similar inscriptions from all EAGLE images.

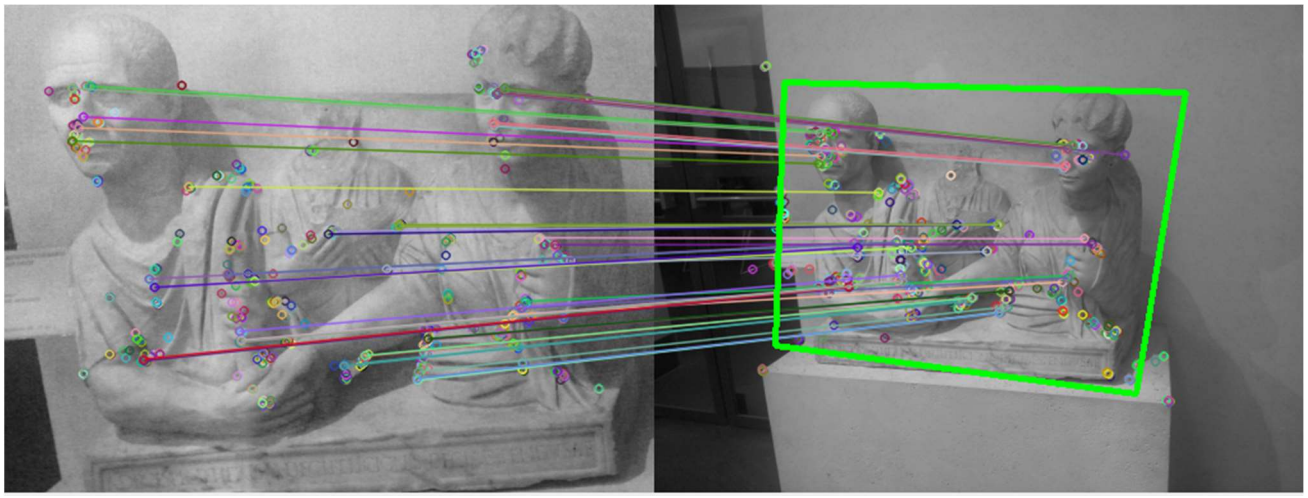

Figure 5 - Example of object recognition.

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Europeana. http://www.europeana.eu/

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