

# Annotations as a Support to Research Users

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**Abstract.** Image digital archives of illuminated manuscripts can become a useful tool for researchers in different disciplines. To this aim, it is proposed to provide them with tools for annotating images to disclose hidden relationships between illustrations belonging to different works.

## 1 Supporting Research Users of Illuminated Manuscripts

This paper reports the research work about the feasibility of systems that support annotation and personalization of image digital archives [1]. The final goal is to provide final users with tools for performing scientific research. The image digital archives of specific interest are those constituted by images taken from *illuminated manuscripts*, which are the manuscripts that include illustrations and, in the past centuries, were manually and artistically decorated by the application of colours, gold, or silver. Illuminated manuscripts are still the subject of scientific research in different areas, namely history of arts and history of science, and all the disciplines that are related to the content of an illuminated manuscript – e.g., botany, astronomy, and medicine. To this aim, a digital archive of images should be enriched with a set of tools that enables the study of the development of scientific illustrations across the centuries.

One of the most important aims of the research on illuminated manuscripts is the disclosure of hidden relationships between illustrations belonging to different manuscripts. In particular, researchers aim at discovering if illustrations have been copied from images in other manuscripts, if they have been merely inspired by previous work, or if they are directly inspired by the nature. A major user requirement regards the possibility to enrich the digital archive by highlighting explicit relationships that have been discovered by a researcher. In particular, researchers should be able to create links for connecting an image to another image that is related, in some way, to it. It is important to keep in mind that images belong to different manuscripts and their relationships may not be obvious. According to user requirements, the use of annotations has been proposed as a useful way of accessing a digital archive and sharing knowledge in a collaborative environment.

## 2 Annotation Conceptual Schema

Annotations are modeled according to the Entity–Relationship (ER) schema of Figure 1, which is described in detail in [2]. This schema provides us with the

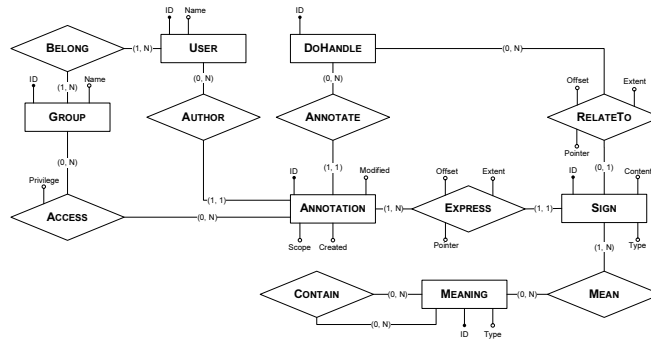


Fig. 1. Entity-Relationship schema for modelling annotations.

grounding for developing the tools and the linking functionalities introduced in Section 1. The ER schema of Figure 1 has the twofold aim of both modelling annotation and using annotations as a linking tool. With respect to the annotation modelling issue, an ANNOTATION is EXPRESSED by one or more SIGNS, such as a piece of text or some graphic mark, which are the way an annotation takes shape; the SIGNS are, in turn, MEANT by one or more MEANINGS, which explain the semantics of each SIGN. With respect to the linking issue, an ANNOTATION must ANNOTATE one and only one digital object, identified by its handle DOHANDLE, while it can RELATETO one or more digital objects. Thus, the ANNOTATE relationship represents the origin of the link, while the RELATETO relationship represents the destination of the link. Note that links not only can be typed by using the MEANING entity, but also they can have a content by using the SIGN entity. In conclusion, the ER schema allows us to exploit annotations as if they were typed links able to carry additional information or data.

### 3 Disclosure of Relationships Inside a Digital Archive

The study on link management highlighted a number of features that is advisable to implement.

- **Link authorship:** The creation of a link between images depends on the scientific results of a researcher, who owns the intellectual rights.
- **Link typology:** Since two images can be related for a number of different reasons, the kind of relationship should be explicit. Different typologies of links are envisaged to take into account the different relationships that may connect two images.
- **Link symmetry:** Each typed link should have a symmetric link that is automatically generated by the system.
- **Paths:** Links may form *historical paths* across images; two images can not be directly linked yet it could be possible to follow a path from one to the other exploiting existing links.

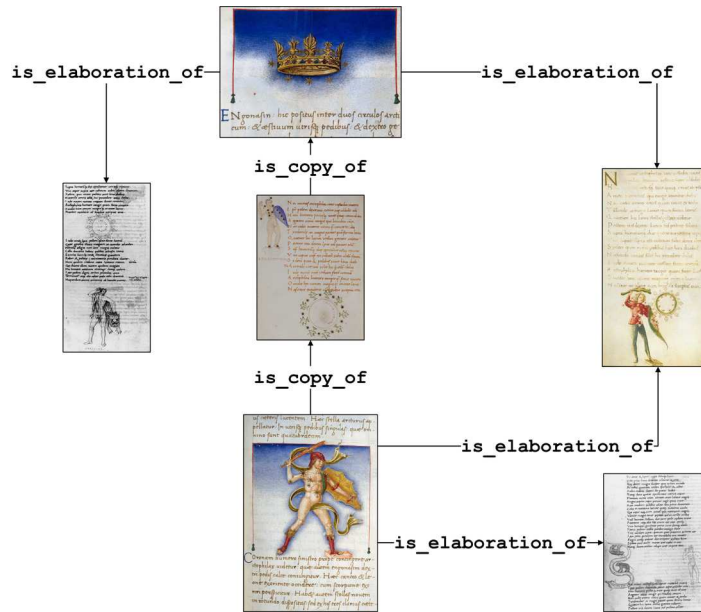


Fig. 2. Example of a personalized view on some linked images.

It can be useful to clarify the notions of link typologies and of historical paths across images, which were a major user requirement. A concept that has been introduced by researchers in the field of illuminated manuscripts is the one of *chains of derivation* across images. Each chain has a *progenitor*, which is an image that has been created through a direct inspection of reality. Subsequent authors may have directly *copied* or *elaborated* that image. These new images may be the source of inspiration for other authors and so on, creating a chain of references to previous works. Moreover, images can be related one to the other because of some similarities between them even if they are not part of the same historical path. Given these considerations, it is proposed to group typed links in two classes; this classification reflects an ontology that is under development according to user requirements and feedback.

The first link class reflects a *hierarchical* relationship between two images, where an image somehow depends on an earlier one. The annotation system automatically adds a symmetric linking annotation, in order to highlight this dependency in both directions. It is proposed to implement three link types of this class: *has\_progenitor\_in*, *is\_copy\_of*, and *is\_elaboration\_of*. The link names should be self explaining according to the our previous discussion on the chains of derivation.

The second link class reflects a *relatedness* relationship between two images, because they share similar properties even though they have been created independently. Also in this case, the system automatically adds a symmetric

annotation, to highlight the relationship in both directions. According to researchers, there may be three motivations to relate images, which are implemented by three new link types: `has_same_model_of`, when the images belong to two different chains of derivation with the same progenitor, `is_similar_to` when images are only visually similar but no other relationship can be stated, and `is_connected_to` when external information highlights a possible connection that is not completely clear from images themselves. The latter link type is motivated by the fact that research on digital archives is an ongoing activity where also partial results should be taken into account.

After a user has added his personal knowledge on the application domain by drawing typed links between images, the digital archive is dynamically enriched by a hypertextual structure. Each researcher may then access differently to the digital archive, because in principle each user has a personalized view of the archive which is given by the hypertextual structure. The existence of such a structure can integrate direct search through navigation inside the image collection. If a mechanism of information sharing inside a user group is provided, as the ones applied to collaborative environments, researchers may cooperate in their study on illuminated manuscripts by sharing the information on relationships between different sources. Figure 2 shows an example of a personalized user view on some linked images. Users may benefit from the visualization of both hierarchical and relatedness relationships among images.

## 4 Conclusions

A mechanism for linking annotations is proposed as a tool for researchers working in a collaborative environment. In particular, linking annotations can be a valuable tool for describing the evolution of scientific illustrations over the years. The proposed approach can be extended also to other application domains, in particular in the field of preservation and dissemination of cultural heritage.

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