Photography as data and metadata: description requirements for information retrieval and semantic interoperability

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Abstract. Images are dominant in the communication field, but the photograph still has a diverse treatment, in terms of description, interpretation and systematic use. The difficulty of searching in collections of images is known, but is diminishing with the potentialities of automatic analysis.This work focuses on the use of the photographic record as a support for research, whether as data, collected or processed, or as metadata, contributing to the description and interpretation of the data, giving them context. With a survey of the production and use of photographic in science, the informational behavior of researchers producing photography will be studied, as well as its relevance for research. Thus, models of image metadata will be developed, and tested with researchers. Through the combination of these models with automatic image processing, we expect to show that images are rich elements to promote the retrieval of research data, fostering semantic interoperability and data reuse.

Keywords: Photography · Research data management · Metadata · Information retrieval.

1 Introduction

Information technology and the prevalence of digital have assumed a prominent role in the information society, promoting the emergence of new trends and making resources highly valuable. Photograph production has become commonplace, due to the availability of image capture devices. Allied to this, the evolution in terms of storage capacity and price encourages the production and storage of images.

In the field of Information Science, particularly in research data management, photography tends to be an ally of researchers to capture evidence and record facts associated with research. In a number of cases, it can also be a major part of datasets, and can be organized and described in information systems, to be reused when necessary.

This doctoral proposal focuses on photography and seeks to understand how this document typology can be fundamental to support research, either as data or

as metadata. As a second goal, it will enquire if and how data curation, combined with automatic image processing tools, can promote better representation and retrieval of information.

2 Preliminary Literature Review

The scientific character of the photograph dates from the nineteenth century, when it began to be produced in Astronomy projects [9]. It was soon realized that it had great potential, given its great capacity of representation, and began to be seen as a "perfect imitation of its object of duplicity" [8].

Silva [9] discusses how photography can unleash the phenomena of "know-see", stating that it has characteristics that allow it to perform unique brain actions of memory and recognition. To prove this thesis are the studies of Czerwinski and Horvitz [3] and Elsweiler, Ruthven and Jones [4] who state that humans forget many details of the tasks they perform, some months after completing them. However, in the first study, it is stated that when confronted with images or videos they tend to remember more quickly what had been forgotten and in the second study, with the help of notes, they easily recall what was apparently no longer remembered.

Photography constitutes a challenge for the information and communication society, since it mediates the guarantee of communicational diversity, the achievement of freedom of expression and respect for visual language [12]. Lacerda [6] also points out several features of photography, from the capacity to record actions and information, to the competence to be a carrier of materiality and of different communication and expression resources.

Palmer et al. [7] analyze the importance of creating a structure of principles and processes that help to articulate and support the description of data. One point of consensus was the key role of photographs as metadata for research documentation. For researchers, the photographs have a double role: they function as metadata (providing context) and as a vital medium to record the object of study. This approach leaves room for positioning photography in research data management, as a fundamental asset in the description and interpretation of specific domains.

Al Nasar, Mohd and Ali [1] talk about the role of human behaviors in the life cycle of photographs. They mention that the awareness and education of others for the practices of photographic record description is essential, commenting on the importance of eliminating description mistakes that the automatic systems contain. Also Kang, Bederson and Suh [5], Suh and Bederson [11], Sinha and Jain [10] and Mota et al. [14] focus on the issues of automatic processing, reflecting on how they should be combined with human interaction for evaluation and error correction.

Research data management is increasingly a concern for researchers who need support in the organization of their data [2]. This constitutes a valuable contribution to information management, since, through description, data keep their meaning and are more easily interpreted, bridging the limitations of human

memory. In addition, data management can be fundamental in the communication between researchers and the scientific community where photography can play a central role in the "teaching-learning" process [13].

3 Proposed Research

This work has a set of general objectives that will be accomplished with a plan divided in three working periods, each one addressing specific objectives.

3.1 General Objectives

Given the importance of the image and the need to integrate it into science, in particular in the research process, a set of general objectives have been defined. These objectives are expected to be accomplished in three different working periods.

The work aims to 1) raise the awareness to the use of photography in research, showing its relevance, suggesting consistent and standardized practices; 2) show that the information retrieval process in the context of research data can be improved by the use of photography as data and as metadata; and 3) demonstrate that the reuse of research data can be fostered by the use of photography as data and as metadata.

3.2 Methodology

Three working periods are defined to fulfill the specified objectives. Each of them has a set of specific goals.

In the first period, called exploration, a framework of photographic production in science will be defined, through an exploratory study. An additional objective is to evaluate the informational behavior of researchers producing photographs, and to understand the life cycle and the importance of photographs in their projects. An understanding of the role that researchers attribute to photography in different scientific areas is also expected. Finally, this phase includes a survey of techniques and tools used by researchers for the management of photographic documents and of solutions for this purpose.

In the second period, named execution, the main objectives are to identify ontologies and metadata models in the image domain; make a survey of the metadata necessary for the description of images; define specific metadata models for photography, if necessary; propose mechanisms that promote digital memory to overcome the limitations of human memory and validate, together with the researchers, the proposed metadata models.

In the third and last period, called evaluation, we plan to analyze and compare information retrieval in two scenarios: 1) photography as data; 2) photography as metadata. In the scenario number one we plan to evaluate information retrieval: without metadata models; with the proposed metadata models; with

the proposed metadata models and automatic image processing tools. In the second scenario: without the photography for the description; with the photography for the description; with photography and automatic image processing tools for the description.

It is also a goal in this period of work to verify if data management, through domain-specific metadata, promotes a better interpretation of data, and to evaluate the rate of reuse of the data, after the inclusion of the photographs in the research data management processes.

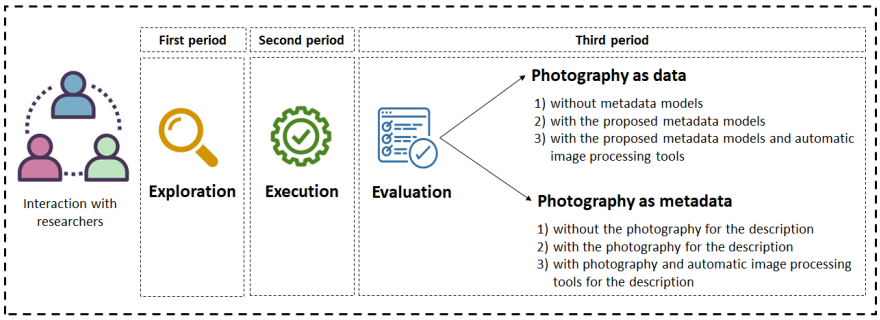

Fig. 1. Research process

4 Future Direction and Expected Contribution

It is important to reflect about the relevance of photography to science. Although there are several benefits associated with this document typology, in previous work this is not widely studied. In this context, photography can appear as metadata, capable of giving other data their context, and as data, captured during the various research processes and integrating a dataset.

In the first case it is possible to claim that photography can be a valuable element to safeguard information, since it precisely captures some of its components. Researchers are therefore given the possibility of recording various details and rest assured that no essential aspect is forgotten due to the limitations of human memory, that does not guarantee the preservation of all the relevant aspects. Thus, human memory is helped by photography.

In the second case, photography may be a consequence of the research process and therefore one of the constituents of a dataset. For this reason, it can be analyzed and processed to generate results and conclusions. Thus, the photograph will be subject to description, enriching it with context and reaching a bigger level of depth that would. The description will contribute to reduce the loss of context, improving the research process from the initial to the final phases.

Description is one of the fundamentals of data management, and its practice by researchers brings numerous advantages. From the point of view of the

image, particularly photography, there are tools that facilitate the identification of the information contained therein, namely through the automatic extraction of attributes and concepts and the recognition of patterns and objects, so that subsequent interpretation is improved. These tools, originated in automatic image processing, aim to expand the boundaries of human vision and offer users additional information about a particular image.

It is undeniable that automatic image processing can be a major contribution to information systems that want to provide efficient data management. It may also constitute a preparatory stage for a more complete and detailed description phase, which can be aided by the metadata models.

Assuming that researchers gather a lot of data and need to store them efficiently, this research will allow us to understand how, combining computation (through existing automatic processing tools) with cognition (through data description techniques), the management and organization of their resources is achieved. Results can be evaluated with the researchers involved in photographic production. This can be accomplished with tests where the retrieval and reuse of information through photography are assessed using the joint effects of automatic image processing tools and data curation.

Images have a significant memory effect on the human brain, establishing links between objects and their contexts, fostering a faster and more efficient understanding. Photography is unavoidable due to its scientific character and therefore can not be removed from the documentary process, since it contributes information in a specific language that is amenable to interpretation and treatment. This work also intends to sensitize researchers to the use of photography, so that they benefit from all its potentialities for the research and the researcher.

It is also a goal of this work to prove that with standardization in the work with scientific photography, inconsistent practices will be reduced, giving rise to more solid techniques, in which the difficulty of interpreting photographs will decrease.

The proposed objectives require interactions with researchers who produce photography. These will take place in the third working period (evaluation) and will be carried out in three phases, as previously described. Figure 1 describes the research process that will lead to accomplish the objectives of the work.

5 Challenges

The proposed doctoral work has several challenges. Some of them are real opportunities for personal and professional development and, above all, opportunities for science.

This proposal requires joint work in information science and computer science. This is a great challenge, since these two areas, together, have a great potential for innovation.

Another challenge is related to the possibility of working with researchers in the area of image processing. Given the solid background in this area in my

host institution (INESC TEC), there is promising support to the collaboration in this area.

Finally, a considerable challenge in this work has to do with human factors. In fact, data curators can not work alone, their involvement with researchers is critical to create the necessary conditions for data management to happen and be successful. It is necessary to educate and sensitize people for these dynamics, so that research data management, particularly with the contribution of photography, is regarded as a great opportunity for research rather than a burden on researchers.

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