

## Chapter 9

# Smart Museum: Semantic Approach to Generation and Presenting Information of Museum Collections

**Svetlana E. Yalovitsyna**

 <https://orcid.org/0000-0001-5024-6357>

*Institute of Linguistics, Literature, and History, Karelian Research Centre of the Russian Academy of Sciences, Russia*

**Valentina V. Volokhova**

 <https://orcid.org/0000-0001-5486-7740>

*Petrozavodsk State University, Russia*

**Dmitry G. Korzun**

 <https://orcid.org/0000-0003-1723-5247>

*Petrozavodsk State University, Russia*

### ABSTRACT

*The chapter presents the authors' study on the smart museum concept. Semantic Web technology and ontology modeling methods are applied to construct advanced digital services, supporting the study and evolution of museum collections. The concept aims at significant increase of the information impact of museum exhibits by providing augmented annotations, identifying semantic relations, assisting the visitors to follow individual trajectories in exposition study, finding relevant information, opening the collection to knowledge from visitors. A museum collection is advanced to a knowledge base where new information is created and evolved by museum visitors and personnel. The chapter discusses reference information assistance services, which are oriented for use as mobile applications on users' smartphones. The proof-of-the-concept case study is the History Museum of Petrozavodsk State University. The pilot implementation demonstrates the feasibility of the smart museum concept in respect to the user mobility, service personalization, and collaborative work opportunity.*

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## **INTRODUCTION**

Nowadays, the museum digitalization is a topical area for applying information and communication technology. Various information services are constructed to extend the value of existing museum collections. A typical museum collection is implemented as a database for storing descriptions on exhibits. This way, the museum information system stores the information part of collection to keep all knowledge related to and about cultural and historical heritage objects (exhibits). The basic function is an electronic archive (catalogue). Its digital extensions lead to “smart services”, emphasizing a certain intelligence level in information search for and delivery to the users.

As we sequentially elaborated previously (Korzun, Marchenkov, Vdovenko, & Petrina, 2016; Petrina, Korzun, Volokhova, Yalovitsyna, & Varfolomeyev, 2017; Korzun, Yalovitsyna, & Volokhova, 2018; Yalovitsyna, Volokhova, & Korzun, 2019), the Internet of Things (IoT) enables advancing a museum information system to “a smart space” where visitors and personnel operate in the shared service-oriented information-centric environment. In particular, study activity of visitors is involved to the museum processes, hence opening many possibilities to engage the museum visitors with exhibits and available descriptive information. This chapter summarizes the authors’ smart museum concept in order to form a semantic service-oriented approach to generating and presenting information of museum collections.

The semantic approach introduces an additional layer on the top of museum information system (the semantic layer). (Marchenkov, Vdovenko, Petrina, & Korzun, 2016) The layer maintains a semantic network of available digitalized descriptions (meaningful information fragments). The semantic layer connects the involved actors (museum personnel and visitors) with the physical exposition. The museum collection becomes not just a large database, where information is consumed in the traditional passive style (visitors are walking around exhibits and reading information from the database). Instead, the museum provides a digital environment where all fragments of the museum exposition become semantically related, leading to easy use and further elaboration by visitors and museum personnel.

To implement the semantic layer, the Semantic Web technology and ontology modeling methods are applied. The semantic network is represented based on the Semantic MediaWiki (SMW) technique (Krötzsch & Vrandečić, 2011). Nodes in the semantic networks are wiki-pages where information representation follows a specific format, both human- and machine- readable. Each page is augmented with semantic information in the form of tags (keywords) and links to other pages. As a result, one can search information based on keywords and connection structure, similarly as information study happens in web browsing in the Internet. This kind of information search is advanced with information ranking when a small set of the most relevant information is provided among many appropriate information fragments. The advance also follows the web technology, where the search results are sorted in accordance with certain priorities to the user (e.g., the well-known PageRank algorithm).

Our proof-of-the-concept case study is the History Museum of Petrozavodsk State University (the History Museum of PetrSU), where the focus is on everyday life history. The pilot implementation considers the following reference museum information services: 1) Visit service to support the visitor with personalized exhibition study plan, 2) Exhibition service to support the visitor with personalized delivery of knowledge on a given exhibit, and 3) Enrichment service to support the museum with a tool for extracting knowledge from visitors.

The goal of this chapter is to summarize the own authors’ experience in the development of smart museum concept. The semantic approach is presented to generating and presenting information of museum collections. The presentation is structured as follows. First, to overview the existing IoT-enabled

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