Chapter 4
Geospatio-Temporal Semantic Web for Cultural Heritage

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ABSTRACT

People frequently need to find knowledge related to places when they plan a leisure trip, when they are executing that plan in a certain place, or when they want to virtually explore a place they have visited in the past. In this chapter the authors present and discuss a set of methods for searching and browsing spatio-temporally referenced knowledge related to cultural objects, e.g. artifacts, photographs and visiting sites. These methods have been implemented in the semantic cultural heritage portal CULTURESAMPO that offers map-based interfaces for a user to explore hundreds of thousands of content objects and points of interest in Finland. Their goal is develop and demonstrate novel ways to help the user 1) to decide where cultural tourists need and are looking for when they visit different places. It has been suggested (Mulrenin, 2002) that museums should publish their activities, collections, services, and products in cooperation with cultural tourism agencies. Indeed, museums and other cultural institutions

INTRODUCTION

There is a strong trend of building up more and more location-aware cultural heritage services (Dijk, Kerstens, & Kresin, 2009)—this is what
host rich collections that have the ability to attract tourists.

There are already several systems that publish cultural heritage content on a map. For example, WatWasWaar.nl publishes historical geographical information in the Netherlands (Liberge & Gerlings, 2008). Another example is Placeography\(^1\) that allows users to share information about places. Furthermore, historical photos have been combined with Google Streetview to provide a possibility to compare historical and contemporary views\(^2\). PhillyHistory.org (Heckert, 2009) also provides a search facility for collections and map visualization, especially for nearby photos of a given location.

**BACKGROUND**

**Semantic Web and Ontologies for Cultural Heritage**

Cultural heritage portals is an especially promising domain for the application of semantic web technologies (Hyvönen, 2009). The idea of the Semantic Web\(^3\) (Berners-Lee et al., 2001) and in particular Semantic Web ontologies (Staab & Studer, 2009) is to offer a “common language” for applications and services to use when they speak about resources, e.g. places, persons, artefacts or events. Semantic Web technologies offer means to describe knowledge about different domains in a machine-processable form as ontologies (Allemang & Hendler, 2008). The goal is to build a “web of data” for machines that can be used to make the current “web of documents” more usable and intelligent for humans.

Ontologies define classes, individuals, properties and relationships that are used to represent things of the world. These things can be anything, like organizations, persons, places, time, or events. By using relationships, persons can be related to e.g. the places they have been born in, or to their birth times. Publishing ontologies on the Semantic Web enables people and organizations to use shared ontologies in annotating e.g. photographs, videos, music, and other types of cultural objects. Search engines can use relationships provided by ontologies in semantic searching and recommendation (Hyvönen et al., 2005).

**Geospatial References and Relationships**

A large proportion of cultural resources such as museums, monuments, photographs, videos, artefacts, and books are geographically referenced, and thus can be identified by search terms that refer to locations (Jones et al., 2001, Stuckenschmidt & Harmelen, 2004). This is because the objects are produced, found or used in the referenced locations, or have some other relationship to the location in question. By georeferencing the resources (Schlieder et al., 2001), spatial queries can be used to find interesting connections between places and related contents.

In recent years there has been effort to provide solutions for finding nearby points of interest, given a certain coordinate point, or more generally “relating spatial things together based on their distance in meters” (Auer et al., 2009). Distances have been modelled with qualitative concepts, such as “far” and “close” (Frank, 1992). Given a certain query point, these notions have a quantitative interpretation, e.g., the circular area around the point with some radius. The search results can then be ranked based on their distance from the center.

Places also relate to each other in different qualitative ways. Traditionally this has been modelled using spatial relations such as topological relations (overlaps, disjoint, etc.) (Egenhofer, 1989), and relations expressing directions (north of, south of, etc.) or distances (far, close) (Frank, 1992). Places relate to each other also due to the cultural connections between them (Kauppinen et al., 2009) or because they share something, for example a common twin town (Auer & Lehm-