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Modeling human daily preferences through a context-aware web-mapping system using semantic technologies

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HIGHLIGHTS

- Provides a methodology for modeling human life patterns.
- Users can customize their policies without relying on the developers.
- Deals with some disadvantages of knowledge-based systems.
- Uses and extends the well-known schema.org ontology for interoperability.
- It deploys a methodology for sharing rules in a social context.

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ABSTRACT

In this paper, a novel geosocial networking service called "G-SPLIS" (Geosocial Semantic Personalized Location Information System) is presented. The paper provides a methodology to design, implement and share in a formal way human daily preferences regarding points of interest (POIs) and POI owners' group targeted offering policies, via user-defined preferences and policy rules. By adding rules at run time users have more flexibility and they do not rely on the pre-determined application's methods to get personalized information. Furthermore, G-SPLIS provides a large knowledge base for other systems in the web, because rules are easily sharable. To achieve the above, the presented system is compatible with Semantic Web standards such as the schema.org ontology and uses RuleML for rules that define regular users' preferences and POI owner's group-targeted offers. Finally, it combines at run-time the above to match user context with related information and visualizes personalized information.

1. Introduction

During the past few years, Location-Based Social Networking Services (LBSNSs) have gained a huge commercial recognition [1–3]. Applications such as Facebook Places,[1] Foursquare[2] and CitySense[3] are used on a daily basis by millions of people. They are commercial applications that display users' geographical positions via representations on a map, enhanced with a social layer [2,3]. By utilizing people collaboration and community-based knowledge they enable a higher perception of

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1 https://www.facebook.com/about/location.
2 https://foursquare.com/.
3 https://www.sensenetworks.com/products/macrosense-technology-platform/citysense/.

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a local area than traditional LBS [4,5]. Successful LBSNSs should offer relevant and proactive information delivery to their users [6,7]. To achieve this, researchers and industries focus on collecting and utilizing contextual knowledge, every piece of information which is useful for inferring a user's situation and determining his/her requirements [6–8]. For example, data concerning profile (e.g. job), environment (e.g. location), social relationships (e.g. friends) and other are gathered for this purpose.

One of the most common methods to enhance contextual knowledge collection and perception process is the use of semantic web standards such as RDF/S and OWL (usually referred as ontologies) [8]. Ontologies offer the ability to represent the structure of physical entities and the associations between them (e.g. representing concepts such as user profiles, places, etc.). Apart from this, they enable knowledge sharing and semantic interoperability, through reasoning. They allow seamless communication between heterogeneous systems, by providing a formal and general knowledge representation and reasoning standard [9–12]. Finally, they provide flexibility, since they can be reused and extended easily, saving a lot of time and effort for developers.

Context perception can be efficiently improved by combining ontologies with rules. Rule-based systems are more autonomous than systems that do not use rules because they are capable of conceiving context changes and respond accordingly without user intervention. Furthermore, they are more proactive, offering services beforehand [13,14]. Such examples are OWL 2 RL [15] and SRWL [16].

In this work, an innovative location-based social networking service called "G-SPLIS[4]" [17,18] will be presented in order to demonstrate how semantic web technologies can enhance LBSNSs and offer qualitative contextualized information to their users. G-SPLIS is an extension of a system called "SPLIS" which was presented in EC-Web 2013 [19]. "SPLIS" functionalities can be summarized as follows:

1. Collects POI data from Google Places API.
2. Is compatible with a widely accepted ontology such as schema.org to represent persons' profiles, POIs and their relations.
3. Offers POI owners the capability to enrich the schema at run time by adding their own properties.
4. Provides POI owners with a form-based web interface in order to deploy their offers according to their policy, regarding the appropriate target group and the context of each user (user's profile, place, time, weather, etc.).
5. Transforms these offers into machine understandable rules. RuleML format is used for knowledge sharing. Jess translation is employed to make them machine executable.
6. Stores metadata and rules in the form of RDF triples (using Sesame) for interoperability and reusability. Data, by being in RDF form, are system independent and they can be used by third party services using a SPARQL endpoint.
7. Displays personalized information on Google Maps[5] to regular users/potential customers. A user-friendly interface layer provides them with the opportunity to find straight away a place or an offer matching his/her profile.

G-SPLIS is an extension of a previous version combined with social dynamics. Apart from the above:

1. The system collects data concerning persons' profiles (apart from the standard registration form) via two well-known social networks such as Facebook[6] and Google+.[7]
2. Via a user friendly web editor, the system provides to regular users the capability to add their own contextualized rule-based preferences concerning POIs (for example the rule "If time is between 13:00–16:00 and weather is Sunny then I would like to visit a Coffee shop"). The system combines POI data with user context and supports preferences that involve every existing property of a POI, weather condition (e.g. if weather is sunny find me an ice-cream shop), time-day-month condition (e.g. I would like to visit a cinema, if it is Wednesday between 20:00–23:00) or user's location (e.g. I want a grocery store which is closer than 500 m). Data[8] and rules are stored in Sesame in order to be interoperable and shareable with other systems, as described above.
3. Allows the user to use his/her preferences stored in a RuleML file uploaded to his/her Google+ account.
4. Executes and evaluates data and rules (user-defined rules and POI owners' offering policies) on the fly to provide high quality contextualized information to the user presented on Google Maps (relevant places and offers regarding his/her context).
5. Allows users to create social ties and communicate among each other, as in other LBSNSs. Additionally, the system provides users with the capability to share and combine their preferences with those of their nearby friends and matches them with POIs and personalized offers.

The aim of our work is to demonstrate how semantic web technologies can enhance the LBSNSs and offer qualitative contextualized information to their users. In everyday life people have preferences such as "if it is Sunday noon I would like some restaurants that serve Chinese cuisine", etc., which depend on their existing context. Such preferences are not

4 Can be accessed at http://tinyurl.com/GeoSPLIS.

5 http://maps.google.com.

6 https://www.facebook.com/.

7 https://plus.google.com.

8 G-SPLIS Sesame server can be accessed at http://platon.econ.auth.gr:8080/openrdf-sesame and data can be accessed at http://platon.econ.auth.gr:8080/openrdf-sesame/repositories/3.