

CONTEXT AWARE RECOMMENDATION SYSTEM IN TOURISM USING SEMANTIC WEB APPROACH

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Abstract. The concept of linked data emphasizes on Global data space which inherently holds embedded semantic relations based on various mapping approaches. Text based search has least relevance as compared to semantically enabled searching and recommendations. Tourism is ever-growing domain for recommendation and suggestions. This paper proposes an approach which makes use of semantically enabled context for the point of interest and tourist preferences as well. There are several contexts (e.g. user's companion, duration of trip, budget) which has dominant effect on the overall outcome of the search. Recommender system is used to suggest the user for optimized preferences based on ranking.

However this recommendation could be increased manifold if the semantic based concept of context is mapped in these algorithms. Contexts are inherently imprecise because of similar meaning sense. Probabilistic mapping could be used to filter these contexts. The proposed approach in this paper is to make use of semantic context for places which could be mapped with the filtered contexts and thereafter based on user's preferences. This work focuses on existing recommendations algorithm along with proposed ontology and mapping approach to make better recommendation system.

Keywords: Context-aware, semantic mapping, recommendation, RDF graph

Introduction

Most of the user prefers to search through internet regarding new places he has to visit. For unknown places to visit the user needs information about place which comply his personal preferences. Personalization has close relation with context which may be handled through context aware applications. This research focuses on optimizing the search capability by making use of semantic based attributes and context which result in deciding factor for the decision making. For instance, if the person context is child park, it means the deciding priority is child creativity and entertainment. Other aspect is context in which a particular place or event is suitable like if it is raining then indoor activities are preferred over children Park. The aim of this work is to aid the end user about suggestion for tourism on basis of several contexts like weather, companion, transport ease, safety, visit time, entry fee, safety record, emergency management, availability of food items, rest rooms.

Availability of content in unprocessed format is readily available. Many novel approaches for suggestion/ recommendation have emerged centered around social, group and context-aware aspect. Context-aware based system is used to recommend as per users' specific contextual situations, since users usually make different decisions in different situations. For example, users may choose a romantic movie to watch with partner, but prefers a cartoon movie if he or she is going to watch it with kids. Companion, either partner or kid, in this example, is one influential/deciding context factor. Other examples of the contexts could be time, location, weather, and so forth. Since user' preferences and decisions vary from situations to situations, it is necessary to take context into consideration when providing recommendations to the end users [1].

Literature survey

According to X. Lian et al. [1] semantic data are modeled using Resource Description Framework where a triple (subject, predicate, and object) represents a statement with implicit meaning for information/ data interchange.

Automated mapping and merging of vocabulary to integrate voluminous web data for consumption without human involvement has more precision along with high recall has been quoted by authors T. Heath et al. [2].

The underlying RDF structure aids to deduce relation among statements based on approach like element-level or structure-level. Figure 1 lists some of the matching techniques as proposed by authors Shvaiko and Euzenat [3].

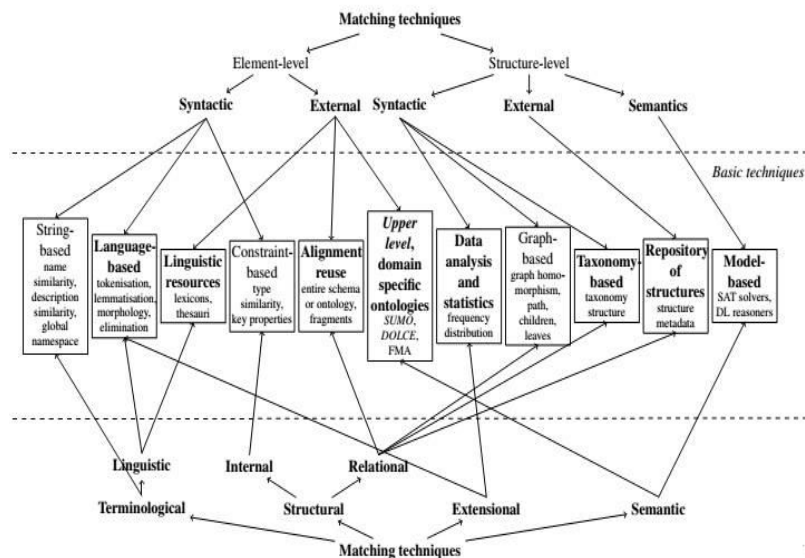


Fig. 1. Vocabulary matching approach [3]

Authors Y.S Sneha [4] proposed that semantic information of documents aids in recommending on the basis of navigational pattern of users. Architecture for e-commerce has been proposed by author.

According to Bobadilla et al. [5] recommender systems have developed in parallel with the web. Initially demographic, content-based and collaborative filtering approach were prevalent and now they are incorporating social information along with local and personal information from the Interrelated contents.

Context aware recommendation focuses on how to build context-aware recommendation algorithms to recommend items in specific situations. For example, which restaurant I should choose if I am going to have a formal business dinner with a company director. Whereas context recommendation aims to suggest appropriate contexts for the users to consume the item. For example, which could be the probable contexts for me to watch the movie “Mogli”? Potential answers could be seeing it in a theater with your children at weekend[6].

Borras et al. [7]made a survey of intelligent recommendation systems for tourism. Especially theory focused on tourism recommenders that made use of Artificial Intelligence (AI) techniques. They discussed about intelligent autonomous agents, automated planners, Ant Colony Optimization (ACO), meta-heuristic methods, automatic clustering, Bayesian networks, and ontology formalisms.

Shambour & Lu[8] built an e-business recommender system which is fusion and trust-semantic based. They enhanced collaborative filtering (CF) with user based trust for making recommender system.

Balduini et al. [9]proposed a location based recommender system that analyzes social streams in order to make personalized recommendations.

Baltrunas et al.[10] focused on Context-Aware Recommender System (CARS) that exploits user preferences and also specific context in which users chose preferences. With respect to tourism there are many contextual factors like budget, time of the day, day of the week, distance, and knowledge about area. They proposed a method to find out relationship between item ratings and contextual factors.

Moreno et al. [11] proposed a system named E-destination which provides web based interface for context-ware and personalized recommendations on leisure activities and tourism.

Bedi & Richa [12] proposed a new method known as user interest expansion approach that makes use of semantic relatedness between items and interest of user. The concept of spreading activation is used to have user interest expansion. Metrics used for evaluation are F1, diversity, precision and recall. Ontology concept has been used to represent domain knowledge as part of their context aware recommender system.

Nguyen et al. [13] proposed a methodology for identifying cultural heritage resources and rank them. They did it based on geotagged social media to leverage cultural tourism services. Ranking is done based on user context.

Smirnov et al. [14] studied e-tourism and presented a location-based on-board system to implement it in Ford SYNC which is a platform for vehicle infotainment.

Moreno et al. [11] reviewed context-aware recommender systems for tourism. They opined that Tourism Recommender System (TRS) plays an important role in helping travelling tourists to do things easily and make their trip memorable.

Panniello et al. [15] emphasized on contextual (pre-filtering, post filtering and modelling) information in order to know the diversity and accuracy of different recommender systems.

Colombo-Mendoza et al. [16] proposed a context-aware recommender system for recommending movie show times. It is a mobile application named RecomMetz. It was found to be effective in both cold-start and no cold-start scenarios.

Gavalas et al. [17] reviewed mobile recommender systems in tourism domain. They found RSs that consider weather conditions, accessibility features, and budget restrictions and recommend tourist routes.

Wang et al. [18] focused on location recommendations. Towards this end, they studied point-of-interest (POI) semantics and user generated content (UGC) from different social media. They used this information in order to characterize venue based recommendations.

Varfolomeyev et al. [19] studied historical tourism and recommender systems available to get recommendations on historical tourism. They could build a system and provide personalized recommendations with qualitative and quantitative information used to make well informed decisions.

Nelepa & Bobek [20] proposed a rule-based context reasoning platform from the knowledge gained from existing solutions. Their solution was for mobile devices based on context-aware reasoning.

Wu et al. [21] studied recommender systems and underlying applications that provide users with information which is personalized and provides recommendations on a product or service. They classified applications into content based recommenders, collaborative-filtering based recommenders, knowledge-based recommenders, hybrid recommenders, computational – intelligence based recommenders, social network based recommenders, context-awareness based recommenders, and group recommender systems (GRS). They also focused on e-government recommender systems such as G2C recommendation and G2B service recommenders.

Zorrilla et al. [22] proposed a tourism recommender system which is ontology based and multi-stage in nature. It is meant for providing personalized context-aware recommendations to people.

Ge et al. [23] proposed an ontology based recommender system with personalization. They focused on context extraction and local ontology construction. Their system was found effective in quality of results.

Bachrach et al. [24] proposed a methodology based on crowd sourcing which helps people across the globe to contribute doing a project online. Especially they demonstrated how a personalized tourist recommender system can be built using crowd sourcing approach.

Garrido et al. [25] presented smart tourist information points. They achieved it by combining different techniques such as AI technologies, semantics and agents. They built lightweight ontology using OWL and Touristic Information of TERuel for Intelligent Agents (TITERIA) and Artificial Intelligence Modelling Language (AIML). They used notion of artificial actor with which users can interact.

Zheng [26] provided summary of different approaches for recommendations. Zheng also focused on providing context aware recommendations, existing applications or API like CARSKIT and useful insights that can help in doing future research.

Mathur et al. [27] made a survey of tourism ontologies. They found tourism ontologies like Mondeca ontology, Harmonise, QALL-ME ontology, OnTour ontology, HiTough ontology, TAGA, and Getess. They used protégé tool for ontology and SPARQL for representing ontology and making queries respectively.

Mukhopadhyay et al. [28] proposed a method to automatically construct ontology from databases in order to build semantic information.

Bhargava et al. [29] proposed a methodology for automatic ontology construction. This was done for having semantic search facility in healthcare units. Their system was named as Automated Knowledge framework for the Indian Medicinal Plants (AKIMP).

Krotzsch & Rudolph [30] explored the concept of semantic web modelling. They studied the use of W3C recommendation for semantic web modelling. It is known as RDF which is a data model which can provide metadata for resources over WWW. It has machine readable format. Its building blocks are blank nodes, literals and URIs. They found that graphs in the form of RDF are better than other structures for data representation.

Iwendi, C. et al. [31] proposed the impact of online ranking of travel place data on basis of emotions, experience, environment, economy etc. Provides sustainable tourism [31]

Ballesteros-López et al. [32] explored travel destination recommendations most favorable based on similarities of tourist's experiences and cultures.

Gazdar A., Hidri L.[33] referred to Tourism 2.0 paradigm, tourism service tools considers customer experience, time, finance/expense for improved recommended destinations.

Conclusion

Most of the user (Group of user) prefers to search through internet to visit new places. To visit unknown places user needs information about place which satisfies their personal preferences. Personalization has close relation with context (like law and order alert, health issues). At present knowledge from other domains like local newspaper and meteorological weather forecast may be linked via semantic web to recommend place base on various factors. Following are the identified sub problems based on this survey.

1. Ontology construction of preference for personalization
2. Data extraction from world wide web
3. Semantic data set construction for places with tagged context.
4. Semantically enabled knowledge based matching.
5. Group Recommendation on basis of companion's priority.
6. Personalized Travel plan scheduling
7. Evaluation and efficiency

Additional personalized Proposed features for detailed tour planning by making use of knowledge base.

1. Lunch time
2. Dinner time
3. Public transport
4. Private transport
5. Activities (Sports, swimming, other events)

6. Food types

Real time context consideration for relevant recommendation

Attributes	Domain
Weather	Meteorological Weather forecast
Alert (Law and order)	Local newspaper
Celebrity visit	
Crowd (Board exams, Processions etc.)	

1. Automated agents based on machine processable information could be used for integrating heterogenous data from overlapping domains like travel, weather, transportation etc. to aid personalized recommendation in tourism.
2. The approach of Open government data could be utilized to integrate information.
3. The semantic information may be reused for decision making in case of recommendation system.
4. Personalized recommendation for particular individual in group makes use of different parameters either explicit or implicit. Implicit knowledge pertains to play major role in searching travel destination.
5. The mobility of user distinguishes it from other recommender systems which led to incorporate context aware techniques. Recommender system exploits open social networks, blogs, reviews etc. for data analysis and observations.
6. Recommendation for group of people having different preferences needs to be handled with semantic information because of different inclination for each member.
7. The database of activities is mostly static. There is lack of knowledge base.
8. In real time scenario, heterogeneous context such as weather, traffic, law and order issues etc. leads to inconvenience. These extracted information aids in decision making to choose probable destination.

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