Volume 4, Issue 8, August 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Ontology Based Information Retrieval Model in Semantic Web: A Review

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Abstract— World Wide Web is the largest database in the Universe which is mostly understandable by human users and not by machines. It lacks the existence of a semantic structure which maintains interdependency of its components. Presently, search on web is keyword based i.e., information is retrieved on the basis of text search of all available matching URL's / hyperlinks. This may result in the presentation of irrelevant information to the user. In the current web, resources are accessible through hyperlinks to web content spread throughout the world. These links make the physical connections and are not understood by the machines. So there is a lack of relationships which captures the meaning of the links for the machines to understand. The explosion of unstructured data on the world wide-web has generated significantly further interest in the extraction problem, and helped position it as central research goal in the Database, Artificial Intelligence, Data Mining, Information Extraction, Natural Language Processing, and Web communities. Hence information extraction is a logical step to retrieve structured data and the extracted information. Information retrieval is synonymous with "determination of relevance". Information retrieval is described as the task of identifying documents in the collection on the basis of properties approved to the documents by the user requesting the retrieval. This paper presents the literature review Semantic Web Mining, our vision combining the three research areas Semantic Web, Mining and Multi Agent Systems. The basic idea is to improve the results of Mining by exploiting semantic structures in the Web and to make use of Mining techniques with Multi Agent Systems for building the Semantic Web. Here, presented techniques and tools for supporting these tasks. The research describe focuses on using semantics to understand Web navigation data, on using this knowledge for evaluating and improving Web sites and services, and on using mining for helping distributed content generation.

Keywords— Semantic Web, Ontology, Multi Agent Systems, Mining, Information Retrieval

I. ONTOLOGY BASED INFORMATION RETRIEVAL MODEL

Latifur Khan, Dennis McLeod, Eduard Hovy [11] worked on the key problem in achieving efficient and user friendly retrieval is the development of a search mechanism to guarantee delivery of minimal irrelevant information (high precision) while insuring relevant information is not overlooked (high recall). To achieve this, they proposed a potentially powerful and novel approach for the retrieval of audio information. In their research they explained the development of an ontology-based model for the generation of metadata for audio, and the selection of audio information in a user customized manner. Also conclude how the ontology they proposed can be used to generate information selection requests in database queries. Vaclav Snasel, Pavel Moravec, Jaroslav Pokorny [12] presented a basic method of mapping LSI concepts on given ontology (WordNet), used both for retrieval recall improvement and dimension reduction. They offered experimental results for this method on a subset of TREC collection, consisting of Los Angeles Times articles. In their research they had shown, that mapping terms on WordNet hypernyms improves recall, bringing more relevant documents. The LSI filtration enhances recall even more, producing smaller index, too. The question is, whether use expensive method as LSI just for the term filtration. The third approach – using LSI on generated hypernym-by-document matrix has yet to be tested.

Sofia Stamou [13] had discussed keyword-based searching does not always result to the retrieval of qualitative data, basically due to the variety in the vocabulary used to convey alike information. In this paper, introduce a concept-based retrieval model, which tackles vocabulary mismatches through the use of domain-dependent ontologies. In particular, our model explores the information encoded in domain ontologies for indexing documents according to their semantics rather than wordforms. To demonstrate the potential of proposed model built an experimental prototype which employs the topical ontologies for indexing Web documents in terms of their semantics. Zeng Dan [14] worked on Semantic Information Retrieval Based on Ontology to resolve the problem of the accuracy on traditional information retrieval, which brings ontology-based semantic information retrieval. The anthor wlilized the method of establishing the domain semantic model with ontology technology, the membership of concept added to the process of semantic modeling, and to provide semantic annotation to facilitate computer calculation processing. Qin Zhana Xia Zhang, Deren Li [15], proposed a approach to overcome the problems of semantic heterogeneity, the explication of knowledge by means of ontology, which can be used for the identification and association of semantically corresponding concepts

because ontology can explicitly and formally represent concepts and relationships between concepts and can support semantic reasoning according to axioms in it. Ontology has been developed in the context of Artificial Intelligent (AI) to facilitate knowledge sharing and reuse. In this paper, an ontology-based semantic description model is put forward to explicitly represent geographic information semantics in abstract level and concrete level by introducing Ontologies.

Sylvie Ranwez, Vincent Ranwez, Mohameth-François Sy, Jacky Montmain, Michel Crampes [16], in this paper described a request method and an environment based on aggregating models to assess the relevance of documents annotated by concepts of ontology. The selection of documents was then displayed in a semantic map to provide graphical indications that make explicit to what extent they match the user's query; this man/machine interface favored a more interactive exploration of data corpus. The RSV decomposition described in this paper is a good example of the benefit of simultaneously considering two related problems: i) how to rate documents w.r.t. a query ii) how to provide users feedback concerning rating of the documents. Yan Shen, Yuefeng Li, Yue Xu, Renato Iannella, Abdulmohsen Algarni [17], introduced a novel ontology-based approach in terms of a world knowledge base in order to construct personalized ontologies for identifying adequate concept levels for matching user search intents. An iterative mining algorithm is designed for evaluating potential intents level by level until meeting the best result. David Vallet, Miriam Fernández, and Pablo Castells [18], given an approach that can be seen as an evolution of the classic vector-space model, where keyword-based indices are replaced by an ontology-based KB, and a semi-automatic document annotation and weighting procedure is the equivalent of the keyword extraction and indexing process. This models shown that it is possible to develop a consistent ranking algorithm on this basis, yielding measurable improvements with respect to keyword based search, subject to the quality and critical mass of metadata. Proposed Model is an adaptation of the vector-based ranking model that takes advantage of an ontology based knowledge representation.

Axel Reymonet, Jerome Thomas, Nathalie Aussenac-Gilles [19], presented a semantic search engine designed to handle within two separate tools both aspects of semantic IR: semantic indexing and semantic search. search engine only exploits knowledge explicitly mentioned in each request/document, the ability to express causal information in OWL could be taken into account in order to bring closer two symptoms apparently different but which share one (or more) fault(s) as potential origin for a given breakdown. Gaihua Fu, Christopher B. Jones and Alia I. Abdelmoty [20], the query expansion techniques presented in this paper are based on both a domain and a geographical ontology. Different from term-based query expansion techniques, the proposed techniques expand a query by trying to derive its geographical query footprint, and it is specially designed to resolve a spatial query. Various factors, such as types of spatial terms as encoded in the geographical ontology, types of non-spatial terms as encoded in the domain ontology, the semantics of the spatial relationships, their context of use, and satisfiability of initial search result, are taken into account to support expansion of a spatial query. The proposed techniques support the intelligent, flexible treatment of a spatial query when a fuzzy spatial relationship is involved. Some experiments have been carried out to evaluate the performance of the proposed techniques using sample realistic ontologies. Jan Paralic, Ivan Kostial [21], in the proposed model, a new, ontology-based approach to information retrieval (IR) is presented. The system is based on a domain knowledge representation schema in form of ontology. New resources registered within the system are linked to concepts from this ontology. In such a way resources may be retrieved based on the associations and not only based on partial or exact term matching as the use of vector model presumes. The ontology-based retrieval mechanism has been compared with traditional full text search based on vector IR model as well as with the Latent Semantic Indexing method. Zhanjun Li and Karthik Ramani [22], in this paper, described a framework for design information extraction and retrieval that aims at being effective with respect to the content-bearing phrases encountered in unstructured and textual design documents. The centerpiece of our method is the layered design ontology model, where the application ontology is automatically acquired using a shallow natural language processing technique as well as the taxonomies defined in the domain ontology. Sylvie Ranwez, Benjamin Duthil, Mohameth Francois Sy, Jacky Montmain, Patrick Augereau and Vincent Ranwez [23], shown that how can ontology based information retrieval systems may benefit from lexical text analysis and proposed a model, CoLexIR approach ((Conceptual and Lexical Information Retrieval). In CoLexIR visualization interface, retrieved documents are displayed in a semantic map and placed according to their relevance score w.r.t. the query represented as a probe (symbolized as a question mark). The result explanation focuses on both conceptual and passage levels. The higher the score, the closer the document is to the query probe in the semantic map. Stuart Aitken and Sandy Reid in this paper [24], evaluated the use of an explicit domain ontology in an information retrieval tool. The evaluation compares the performance of ontology-enhanced retrieval with keyword retrieval for a fixed set of queries across several data sets. The robustness of the IR approach is assessed by comparing the performance of the tool on the original data set with that on previously unseen data. The empirical evaluation of ontology-based retrieval in CB-IR has broadly confirmed the hypotheses about relative and absolute performance of the system and about the adequacy and robustness of the ontology. Asunción Gómez-Pérez, Fernando Ortiz-Rodríguez, Boris Villazón-Terrazas [25], worked on "Ontology-Based Legal Information Retrieval to Improvethe Information Access in e-Government". In this paper, approach to an ontology-based legal IR, which aims to retrieve government documents in a timely an accurate way.

Pablo Castells, Miriam Fernández, and David Vallet [26], proposed an approach for the adaptation of the Vector-Space Model for Ontology-Based Information Retrieval". Approach could be seen as an evolution of the classic vector-space model, where keyword-based indices are replaced by an ontology-based KB, and a semi-automatic document annotation and weighting procedure is the equivalent of the keyword extraction and indexing process. In this model, shows that it is possible to develop a consistent ranking algorithm on this basis, yielding measurable improvements with respect to keyword-based search, subject to the quality and critical mass of metadata. Jouni Tuominen, Tomi Kauppinen, Kim Viljanen, and Eero Hyvonen [27], proposed an approach on Ontology-Based Query

Expansion Widget for Information Retrieval. In this paper, they have implemented a web widget providing query expansion functionality to web-based systems as an easily integrable service with no need to change the underlying system. The widget uses ontologies to expand the query terms with semantically related concepts. The widget extends the previously developed ONKI Selector widget, which is used for selecting concepts especially for annotation purposes. There are various Ontology based information retrieval methods [28] to search information with enhanced semantics from the user query input to retrieve high relevant information: Vector Space Based Information Retrieval, Probabilistic Information Retrieval, Context Based Information Retrieval, Semantic Based Information Retrieval, Semantic Similarity Based Information Retrieval, Semantic Association Based Information Retrieval and Semantic Annotation Based Information Retrieval. Swathi Rajasurya , Tamizhamudhu Muralidharan , Sandhiya Devi and Dr. S. Swamynathan [29] proposed system Semantic Information Extraction in University Domain(SIEU) is designed. SIEU retrieves the semantically relevant results for the user query by considering the semantics and context of the query. In this thesis, proposed two models, first is on "Ontology Based Information Retrieval through Multi agent System" for content retrieval from the web .Stages involved in development of first model further divided into four parts: Ontology Development, Ontology Mapping, Ontology Mining and Ontology with Multi-Agent system. Literature of each stage classified and explained in next section.

II. ONTOLOGY DEVELOPMENT

Dongpo Deng [31], in this study, author reported the experience of creating the ontology of place name serving as a specification of domain knowledge, as well as used the ontology of place-name to information retrieval. The results show the geographic ontology can to rid of ambiguous of geospatial data. It is a common situation that a place name refers to different places and a place has different names. The ontology of place name might be a useful solution to provide exact result in the Web application. However, the ontology of place name built by feature type might solve the terminology problem of place name, but doesn't figure out the spatial nature of place name. Christopher S.G. Khoo, Jin-Cheon Na, Vivian Wei Wang, and Syin Chan [32], in this a disease-treatment ontology developed to model and represent treatment information found in the abstracts of medical articles. In this paper, described the preliminary version of the disease treatment ontology that can be developed to encode treatment information reported in medical abstracts in the medicine database. The ontology was developed from an analysis of 40 abstract in the domain of colon cancer therapy. Valentina Cordi, Viviana Mascardi, Maurizio Martelli, Leon Sterling [33], discussed a framework for evaluating and comparing methodologies for ontology development and its application to the evaluation of three existing methodologies. The framework is characterised by a domain-independent step and by an application-driven step. It has been adopted to analyse and compare three methodologies, the "Ontology Development 101" methodology, the "Unified Methodology" and EXPLODE, in respect to the analysis, design, verification and implementation of an ontology for content-based retrieval of XML documents. Naveen Malviya, Nishchol Mishra, Santosh Sahu [34], in this paper authors explained the terms of university through university ontology. Also focused on creating the university ontology with the help of protégé tool. Rajiv Gandhi Technical University Bhopal, India had been taken an example for the ontology development and various aspects like: super class and subclass hierarchy, creating a subclass instances for class illustration, query retrieval process visualization view and graph view have been demonstrated**.** Lakshmi Palaniappan, N. Sambasiva Rao, G. V. Uma [35], described how ontologies can then be of help to the user in formulating the information need, the query, and the answers. As a proof of the concept, have shown photos of restaurant. In this system, images are annotated according to ontologies when generating answers to the queries, the ontology combined with the image data also facilitates. This paper showed that ontologies can be used not only for annotation and precise information retrieval , but also for helping the user in formulating the information need and the corresponding query. This is important in applications such as the promotion exhibition, where the domain semantics are complicated and not necessarily known to the user. Norasykin Mohd Zaid and Sim Kim Lau [36], described the "Development of Ontology Information Retrieval System for Novice Researchers in Malaysia". In this paper, authors have proposed a framework that shows that ontology approach can help novice researchers to apply semantic search techniques to improve current search capabilities. Preliminary user interface with simple ontology has been designed.

Sanjay K. Dwivedi and Anand Kumar [37], reveals the conceptualization of university knowledge through construction of university ontology. Generalized structure of Indian universities and workflow processes have been taken for ontology development by describing the class hierarchy, and demonstrate the graphical view of ontology. Authors also demonstrated the ability of university ontology to execute intelligent query to retrieve the information.

III. ONTOLOGY MINING

Amel Grissa Touzi, Hela Ben Massoud and Alaya Ayadi [38], presented their work on automatic ontology generation for data mining using FCA and clustering. In this paper, authors have combined Clustering, FCA and Ontology in order to improve it. For this, proposed a new approach for automatic generation of Fuzzy Ontology of Data Mining, called FODM. C. Antunes [39], discussed an ontology-based framework for mining patterns in the presence of background knowledge. Authors presented a framework that incorporates background knowledge in the core of the mining process, by using domain ontologies and by defining a set of constraints above them, which can guide the discovery process.

Sachin Singh, Pravin Vajirkar, and Yugyung Lee [40], discussed an approach on Context-aware Data Mining using Ontologies. Here, authors introduced a context aware data mining framework which provides accuracy and efficacy to data mining outcomes. Context factors were modeled using Ontological representation. Majigsuren Enkhsaikhan, WilsonWong Wei Liu, Mark Reynolds [41], worked on Measuring Data-Driven Ontology Changes using

Text Mining. In this paper, authors have presented an approach for semi-automatically generating ontology concept clusters at different time periods, measuring and visualising the changes in sensible ways to help understand the overall concept changes as well as the individual terms contributed to the change.

Edmar Augusto Yokome e Fl´avia Linhalis Arantes [42], worked on Meta-DM: An ontology for the data mining domain. In this paper, authors presented the development of domain ontology for data mining. The main result present is the Meta-DM ontology, its conceptualization and implementation. Meta- DM intends to supply a common terminology that can be shared and understood by data mining tools.

IV. ONTOLOGY WITH MULTI AGENT SYSTEMS

Anarosa Alves, Franco Brandão, Viviane Torres da Silva, Carlos José Pereira de Lucena [43], presented a work on a model driven approach to develop multi-Agent Systems. In this paper, authors described a model driven approach to develop multi-agent systems that begins with an ontology based on the TAO conceptual framework. Quynh-Nhu Numi Tran, Graham Low [44], worked on MOBMAS: A methodology for ontology-based multi-agent systems development. In this authors, authors proposed a new framework and compared MOBMAS against sixteen well known methodologies: MaSE, MASSIVE , SODA, GAIA, MESSAGE , Methodology for BDI Agent, INGENIAS, Methodology with High-Level and Intermediate Levels, Methodology for Enterprise Integration, PROMETHEUS, PASSI, ADELFE, COMOMAS , MAS-Common, KADS , CASSIOPEIA and TROPOS.

Pakornpong Pothipruk and Pattarachai Lalitrojwong [45], worked on an Ontology-based Multi-agent System for Matchmaking. Csongor Nyulas, Martin J. O'Connor, Samson Tu1, David L. Buckeridge, Anna Akhmatovskaia, Mark A. Musen [46], presented their work on An Ontology-Driven Framework for Deploying JADE Agent Systems. Authors described a methodology and suite of tools to support the modeling and deployment of agents on the JADE platform. These models are encoded using the Semantic Web ontology language OWL and provide detailed computer-interpretable specifications of agent behavior in a JADE system.

Gajun Ganendran, Quynh-Nhu Tran, Pronab Ganguly, Pradeep Ray and Graham Low [47], proposed a methodology on An Ontology-driven Multi-agent approach for Healthcare. In this paper, authors described an ontology-driven multi-agent approach to the development of healthcare systems, with a case study in diabetes management.
Wongthongtham, P., Chang, E., Dillon, T.S. [48], worked on Ontology-based Multi-agent system to Multi-site Software Development. Authors described software agent utilized ontology as its intelligence in MSSD and found that it has benefits. Ontology gives computers more knowledge that the agent can utilize.

Maja Hadzic, Elizabeth Chang [49], worked on use of ontology-based multi-agent systems in the biomedical domain. Authors have shown how the ontologies can be used by multi-agent systems in intelligent information retrieval processes. The ontologies can be used to support some important processes involved in the information retrieval such as posing queries by the user, problem decomposition and task sharing among different agents, result sharing and analysis, information selection and integration, and structured presentation of theassembled information to the user.

V. CONCLUSIONS

As per literature studied, Semantic Web and Ontology development have many benefits in the information retrieval area. Many researchers have worked on different technologies of Semantic Web and implemented on particular domain. In this paper, various approaches of Ontology Based Information Retrieval Model have been discussed. A new model can be defined with the use of Mining in Ontology with Multi Agent system for information retrieval, whereas ontology can be use as a repository, mining for data extraction and multi agent system can be use for data representation. This paper will also helpful to other researchers, who would like to do work in this area.

ACKNOWLEDGMENT

I, Vishal Jain, would to give my sincere thanks to Dr. M. N. Hoda, Director, Bharati Vidyapeeth's Institute of Computer Applications and Management (BVICAM), New Delhi, for giving me opportunity to do Ph.D from Linagay's University, Faridabad..

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