RESEARCH ARTICLE OPEN ACCESS

A Semantic Link Network Based Search Engine For Multimedia Files

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ABSTRACT

This paper, presents the state of art in the field of multimedia data mining and knowledge discovery by establishing the relationships between the tags and properties associate to the multimedia files to create a semantic link network for further retrieval of multimedia data with the help of an intelligent semantic browser. A Semantic Link Network (SLN) consists of nodes (entities, features, concepts, schemas or communities) and Semantic Link between those nodes. This paper proposes an autonomous Semantic Link Network formation between image files stored in database based on their alternative tag properties to support intelligent application on large scale clustering and retrieval of image files. This proposes a whole model of generating the association relation between multimedia resources using Semantic Link Network. The integration between the semantic link network and multimedia resources produces a new prospect for organizing and retrieving those multimedia files.

Keywords:- Semantic Link Network, Multimedia Resources, Semantic Web, Social Tags, Big Data

I. INTRODUCTION

Big data is the new technology used to categorize the data sets that are very large in size and structure, thus we cannot process it with our pre existing method and tools. In recent few years we are just collecting various data from different sources for our further usage. Thus it is very important for using correct methods and tools to cluster and retrieve these data for the best use of resources. Thus big data mining is the process of extracting useful data from the whole database. As the complete data base, due to its complexity, volume, size and variety it is very difficult to extract data from database.

Recent years there is a gigantic increase in data collection from various resources, devices, in different formats from any kind of application. Due to this excessive amount of data coming through has outpaced our ability to process, analyze, retrieve and understand those data sets.

5 V's of big data:-

- Volume – increase in data is far more rapid than our tools to process them.
- Variety – almost all kind of data that we can process
- Velocity – speed of data clustering is so fast that we are not able to retrieve useful information and co relations in real time.
- Variability – data structure and interpretation is changing constantly.
- Value – business value which helps in enhancement of performance.

Understanding and establishing the relations between multimedia file has been an important part of many multimedia based applications. One of the preferred way of establishing relationship between multimedia files relies on manual annotation and tagging but unlikely others multimedia annotation is time consuming and expensive when dealing with very huge scale of multimedia data.

Thus multimedia database[10] should provide

1. Content based access
2. Knowledge discovery
3. Scalability to large data volumes
4. Good run time performance
5. Scalability to high dimensionality of features

In this paper, Semantic link network model is used for organizing and retrieval of multimedia resources with social tags[4]. Many social media sites like facebook, YouTube, flicker, etc allows user to upload images with descriptive keywords or annotations which are called social tags. The tags and surrounding keywords are used to represent the semantic content of any multimedia file. The semantic link network[5] is for establishing semantic relationships among various resources (data, image, and various document) aiming at extending the reach of hyperlink network world wide web to a semantic rich

network.

A Semantic Link Network consists of semantic nodes and semantic link or relation between those nodes. A semantic node can be schema, a concept, an entity, a feature or an identity.

Semantic Web[3, 9] is an evolving development of the World Wide Web, in which the meanings of information on the web are defined and contents are associated together on the basis of those meanings. Compared with World Wide Web, the Semantic Link Network has following advantages.

i. Supports Semantic Web browsing and reasoning at both the entity and the abstraction level
ii. Provides not only the answer but also relevant contents that semantically link to answers.

The general semantic rules are independent from domain so they can be used as knowledge for reasoning on any semantic link network. Example[6]:

a. "A—use → X, B—use → X" it implies that " A shares something with B"
   ⇨" A—share → B"
b. " A—develop → X, B—develop → X" means that "A cooperates with B"
   ⇨"A—cooperate → B".

A semantic link can be one of the following seven types[8]:

- Cause effective link
- Implication link
- Subtype link
- Similar to link
- Instance link
- Sequential link
- Reference link

This paper presents the design and implementation of intelligent semantic browser which can access the semantic link network across the database for enhanced searching options for the multimedia data files.

II. GENERAL ARCHITECTURE

The Semantic link network is a semantic web model using semantic link to extend the hyperlink of the current web[7].

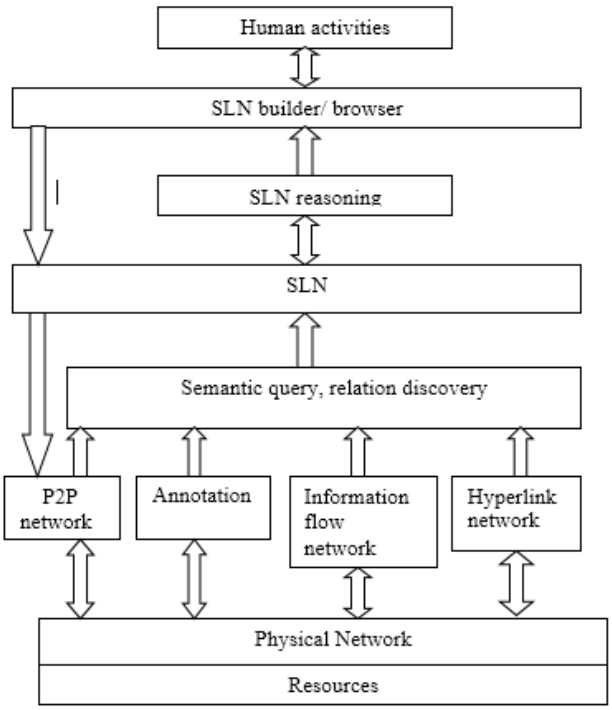

Fig.2.1 – General architecture of semantic link network.

The intelligent semantic browser[7] has these components:-

- The reasoning rule set,
- The reasoning mechanism,
- The html converter,
- The browser interface of a search engine.

The reasoning rule set contains the rules for describing the characteristics of a semantic link.

The html converter transforms the xml description of the semantic link network and the reasoning result into a form of web page. So, the browser can display the result of users query.

The reasoning mechanism is responsible for searching and establishing the relationship between entities on the basis of their descriptive properties.

III. BASIC MECHANISM OF PROPOSED MODEL

The proposed model has components:

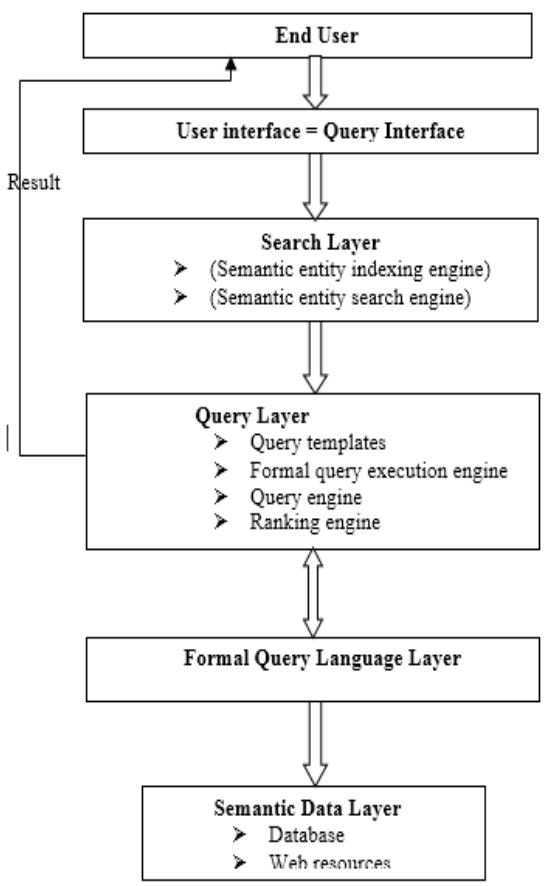

Fig.3.1 – Mechanisms of proposed model.

I. *Semantic Entity Index Engine[2]:*
It indexes documents and their associated semantic entities like classes, properties and individuals.

II. *Semantic Entity Search Engine:*
Responsible for searching of entity matches for the user keywords.

III. *Semantic Query Layer:*
a. A formal query construction engine which translates user query into formal query.
b. A query engine, which executes query.
c. A ranking engine which ranks the results of the user's query.

IV. *Formal Query Language Layer:*
It provides specific formal query language for further processes.

V. *Semantic Data Layer:*
It comprises semantic metadata.

IV. BASIC APPROACH OF PROPOSED MODEL

The Semantic Link Network (SLN) was proposed as a semantic data model for organizing various Web resources by extending the Web's hyperlink to a semantic link.

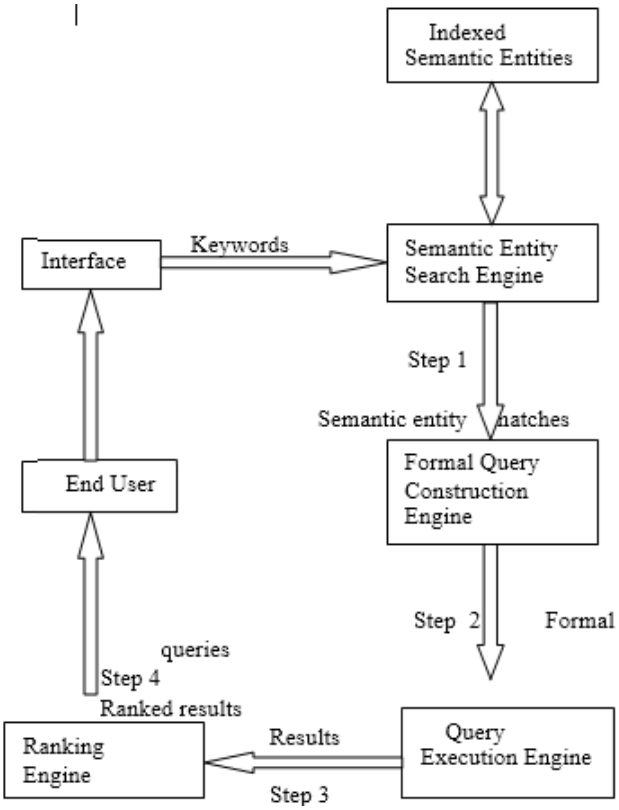

Fig.4.1 - Stepwise process execution.

A formal query in SeRQL comprises three building blocks:

a) The head block, which describes what needs to be retrieved,
b) The body block, which describes how,
c) The condition block, it expresses condition.

We can use Sesame[12] & Lucene[12]. Seasme provides a query language for semantic data represented in RDF. Lucene provides a text search engine, which can be used for building the semantic entity index engine and the semantic entity search engine.

V. MIDDLEWARE

1. *Making Sense of The User Query:*
Here task is to find out the semantic meaning of the keywords specified in a user's query.
One keyword may match:-

a) General concept, e.g., engineer,
b) Semantic relationship between concept, e.g., keyword "author" matches the relation "has author",
c) Instances entities, e.g., "engineer" matches someone with job title engineer.

To achieve this search engine must index all the semantic entities and SLN between them contained in the back end semantic data repositories, including classes, properties and instances. Thus, two components must be developed namely, the semantic entity index engine and the semantic entity search engine.

2. *Translating The User Query Into Formal Query:*
   Search engine takes an input, matches the semantic of users search terms and outputs an appropriate formal query according to the semantic meaning of keywords including:
   - Query Templates,
   - Query Formulation.

   To construct formal queries, the search engine needs to combine the semantic matches together and construct sub queries for each of the combinations.
   - Combining different keywords.

3. *Rules for consideration:*
   a) The subject keyword always matches class entities when there are more than two keywords involved in user's query.
   b) Choose the closest entity matches of the keyword.
   c) Choose the most specific class match among the class matches.

4. *Formulating formal queries:*
   For each combination of semantic matches a formal query needs to be constructed. The relations and the related instances also need to be pulled out, which explains the search results.

VI. RELATEDNESS BETWEEN TAGS

Table1.
The variations and data values used in the proposed model:-

Value	Description
m	A multimedia resource
t	A tag
s(m)	Set of tag of resource
$r(t_1 , t_2)$	Semantic relatedness of two tags
$r(m_1, m_2)$	Semantic relatedness between 2 resources
C(t)	Page counts of a tag
C(s(m))	Page count of a set of tags of a resource
P(t)	Position information of a tag

Step 1:- Tags of two multimedia resources m_1 & m_2 is denoted as:-

$$s(m_1) = \{t_1, t_{2,\ldots,} t_{|s(m1)|}\}$$
$$s(m_2) = \{t_1, t_{2,\ldots,} t_{|s(m2)|}\}$$

Step 2:- Tags of m_1 & m_2 are queried to the web search engine, page counts are denoted as:-

$$C(s(m_1)) = \{C(t_1), C(t_2),\ldots, C(t_{|s(m1)|})\}$$
$$C(s(m_2)) = \{C(t_1), C(t_2),\ldots, C(t_{|s(m2)|})\}$$

Step 3:- PMI for computing relatedness equation can be:-

$$r(t_i , t_j) = \frac{\log \left(\frac{C*C(t_i \cap t_j)}{C(t_i) * C(t_j)}\right)}{\log C}, \; t_i \varepsilon\, s(m_1) \wedge t_j \varepsilon\, s(m_2)$$

The mutual information (MI) of two random variables is a quality that measures the mutual dependence of the two variables.
Point wise mutual information (PMI) is a variant of MI.

VII. RELATEDNESS BETWEEN RESOURCES

The tag pair relatedness of 2 multimedia resources m_1 & m_2
Can be treated as a bipartite graph, as:

$$G = (V, E)$$
$$V = \{m_1, m_2\}$$
$$E = < t_i , t_j , r(t_i , t_j) >,$$
$$t_i \varepsilon\, s(m_1) \wedge t_j \varepsilon\, s(m_2)$$

$$\text{maxRel}^1.(m, m_1, m_2)$$

$$= \frac{\max \sum_{(j \varepsilon J)} \sum_{(I \varepsilon I)} s(t_i , t_j), \; |s(m_1)| \leq |s(m_2)|}{|s(m_1)|}$$

$$= \frac{\max \sum_{(j \varepsilon J)} \sum_{(I \varepsilon I)} s(t_i , t_j), \; |s(m_1)| > |s(m_2)|}{|s(m_2)|}$$

$$I = [1\ldots.|s(m_1)|]$$
$$J = [1\ldots.|s(m_2)|]$$

VIII. RESULT RANKING

Two factors for consideration while ranking:-

i. Matching distance between each keyword and its semantic matches.
ii. Numbers of keywords the search result satisfy.

Algorithm[1]: -

Input: - the tag sets of images m_1 and m_2 which is s (m_1) and s (m_2).

Output: -

For each $t_i \varepsilon$ s (m_1)
C(s (m_1)) ← C (t_i);
P(s (m_1)) ← P (t_i);
For each $t_j \varepsilon$ s (m_2)
C(s (m_2)) ← C (t_j);
P(s (m_2)) ← P (t_j);
For each $t_i \varepsilon$ s (m_1)
For each $t_j \varepsilon$ s (m_2)

if (t_i == t_j) r (t_i , t_j) = 0;

Else r (t_i , t_j) = m(C(t_i), C(t_j));
Return maxRel (m_1, m2) = m (P (t_i), P (t_j), r (t_i , t_j))

IX. APPLICATION

→ Content Based Image Retrieval (CBIR)[11]. "Content Based" means the search analyzes the contents of the image rather than the metadata. Term "Content" may refer to anything or any information that is associated to image. It provides better indexing mechanism and returns more accurate results.

→ It can be used for searching any kind of multimedia files other than images, like audios, videos, etc.

→ It provides ontology based queries. The proposed semantic search mechanism based on SLN consist the searching method. Users can only choose the attributes or concepts that are defined as the queries for search engine.

→ Associated search suggestions according to the user history of search and relatedness to other tags of multimedia files according to the association rules and relations.

X. CONCLUSION

Organizing multimedia files in such a way that user can perform fast, effective and efficient clustering and retrieval operations is a challenging task, and thus different solutions have proposed over the years, trying to address different angles of the problem. Social multimedia indexing and retrieval in the very large databases of the social networks advanced the challenges to find new techniques and solutions. The research on image semantics is undergoing a paradigm shift as the social media sharing and social tags are growing exponentially. The added context has broadened the scope of semantic interpretation behind the curtains.

Semantic Link Network (SLN) is designed to establish associated relations among various resources aiming at extending the loosely connected networks of no semantics towards the association rich network. In the proposed Semantic Link Network (SLN), the relatedness between tags and other description of the resources are implemented. The tags and other surrounding text properties of resources are used to represent the semantic content. It proposes very effective and efficient way towards several Web intelligent activities such as browsing, knowledge discovery, publishing, searching, etc. Here, two of the data mining tasks clustering and retrieval are performed. Semantic search promises to produce precise answer to the user's queries. The main purpose of the intelligent semantic browser is to hide the complexity from the end user and make it easy to use and effective in any case. The proposed model helps in make use of the file related metadata and other links associated which plays the key role in advanced data organization concepts.

REFERENCES

[1] Chuanping Hu, Yunhuai Liu, Lan Chen and Xiangfeng Luo, "Semantic link network-based model for organizing multimedia big data", *IEEE Transaction on emerging topics in computing*, April 2014.
[2] Donia Ana Cernea, Esther Del Moral, Jose E. Labra Gayo, "SOAF: semantic indexing system based on collaborative tagging", vol.4, 2008.
[3] T. Berners-Lee, J. Hendler, and O. Lassila, "The semantic web," *Sci. Amer.*, vol. 284, no. 5, pp. 28_37, 2001.
[4] H. Ma, J. Zhu, M. R.-T. Lyu, and I. King, "Bridging the semantic gap between image contents and tags," *IEEE Trans. Multimedia*, vol. 12, no. 5, pp. 462_473, Aug. 2010.
[5] H. Zhuge, "Communities and emerging semantics in semantic link network: Discovery and learning," *IEEE Trans. Knowl. Data Eng.*, vol. 21, no. 6, pp. 785_799, Jun. 2009.
[6] X. Luo, Z. Xu, J. Yu, and X. Chen, "Building association link network for semantic link on web resources," *IEEE Trans. Autom. Sci. Eng.*, vol. 8, no. 3, pp. 482_494, Jul. 2011.
[7] H. Zhuge, R. Jia and J. Liu, "Semantic link network builder and intelligent semantic browser", *Concurrency Computat.: Pract. Exper.* 2004; 16:1453–1476.

[8] Heflin J, Hendler J, "A portrait of the Semantic Web in action", IEEE *Intelligent Systems* 2001; 16(2):54–59.
[9] Semantic Web. http://www.w3.org/2001/sw/.
[10] Srihari RK, Zhang Z, Rao A, "Intelligent indexing and semantic retrieval of multimodal documents", *Information Retrieval* 2000; 2:245–275
[11] M. Batko, F. Falchi, C. Lucchese, D. Novak, R. Perego, F. Rabitti, J. Sedmidubsky, and P. Zezula, "Building a Web-scale Image Similarity Search System", *Journal of Multimedia Tools and Applications*, vol. 47, no. 3, pp. 599-629, 2010.
[12] T. Chiueh, "Content-based image indexing", in *Proc. 20th Conference on Very Large Databases (VLDB)*, 1994, pp. 582-593.

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