

A Proposed Research Framework for Semantic Social Network Analysis

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Abstract : In the present scenario, social networks and social networking platforms are growing very rapidly. Therefore, analysis of these networks has become quite significant. In this regard, social network analysis may be performed in a better way by embedding some semantics to it. Semantic social network analysis is prominent for node visualization and analysis to yield better results. In this context, the need is to provide some research frameworks for semantic social networks analysis and to explore various research issues regarding the role of concerned key technologies like ontology and SPARQL. In this paper, first, origin and growth of social networks and social network analysis have been presented. Second, a few significant tools for social network analysis have been presented along with a comparative study of their different features. Third, a research framework is proposed for semantic social network analysis along with steps related to it. Fourth, various significant research concerns of semantic social network analysis in regard to ontology and SPARQL have been explored. Finally future scope and conclusion is being made.

IndexTerms - Semantic Social Networks, Social Network Analysis (SNA), SPARQL, Ontology, Semantic Social Network Analysis, SNA Research concerns.

I.INTRODUCTION

These days, the web is being considered as the most important mode of communicating to different people all over the world and the web is transformed into more of social web creating a huge amount of content which is shared as well as produced widely online [1]. In recent times, people are constantly using web either to retrieve some information or sharing the content with others. Millions of users are sharing some information over the web creating a huge bulk of data that have to be evaluated and managed properly [3]. Semantic web is a vision that the current web will embed some meaning to the human readable content to further enhance it into machine understandable semantics [3]. Therefore, Social networks play a significant role in present web.

Social networks that are web based are treated as the most crucial medium for sharing and transferring of the data online. In the current situation, several social networking sites have increased the number of users as well as the amount of content being shared over the web [4]. The key elements of social networks are interactive tools and platforms like instagram, facebook, twitter etc. So, the analysis of Social networks have become a wide research area as it brings social sciences and computer science together. A lot of researchers are inclined towards this area as it is growing rapidly gaining attention in recent years from various disciplines [5]. Social networks may be visualized in the form of graphs where nodes are represented by people and the arrows depict the relationship among them. There may be different type of relationship such as asymmetric and symmetric[6]. Asymmetric relationships can be represented by unidirectional graphs whereas the symmetric relationships can be represented by bidirectional graphs [6]. Further analysis of such graphs can be done by embedding some semantics to it. These days semantic social networks are gaining popularity as it allows a further analysis by embedding semantics.

Semantic social networks is a way of representing the social network data with the help of some semantics in such a way that further analysis of these networks results in a better way. Social networks embedded with some meaning or semantics with it can be achieved by identifying the key features of the network. There are various factors for which the analysis of such networks is important. For the analysis of social networks, there are various tools which are significant for the visualization and analysis of the nodes and the relationships among them.

For the analysis of social networks various tools are available providing an environment to visualize and create different social networks like SocNetV, UCINET, Gephi, NetworkX, Igraph etc [15][16][17][18] which offer varied functionalities. Since semantic social networks are gaining popularity, the need is to explore the various related research issues.

Major concerns for semantic social networks which may be in regard to semantic web technologies like ontologies and SPARQL. Both of them have a significant role in the analysis of social networks and provide a gateway for the further analysis showing better or desired results.

In this paper, first, origin and growth of social networks and social network analysis has been presented in section II. In Section III, a few significant tools for social network analysis have been presented and revisited along with a comparative study

of different features. In Section IV, a research framework for semantic social network analysis has been proposed along with different steps related to it is being presented. In Section V, a few significant research issues of semantic social network analysis in regard to ontology and SPARQL have been attempted to be explored. It is followed by conclusions, future scope and limitations.

I. LITERATURE SURVEY

II.1. Social Networks

Granovetter [20] emphasis that social networks are being divided into two ties i.e. strong and weak which may further be tightly clustered. Liben-Nowell et al. [21] refers that there is a strong connection between the geographic locations and friendship of social networks. Pool and Kochen [22] presented a small-world effect analysis of social networks. Girvan and Newman [23] observed some of the online social networks users to further form groups. In recent work, Ahn et al [24] analyzed all the data presented in south korean social networking sites with the help of some crawlers.

Many researchers are now a days analysing various social networks present on the web. These social networks can be of two types i.e. explicit social networks and implicit social networks. Implicit social networks are further classified as symmetric and asymmetric relationship social networks as in below figure.

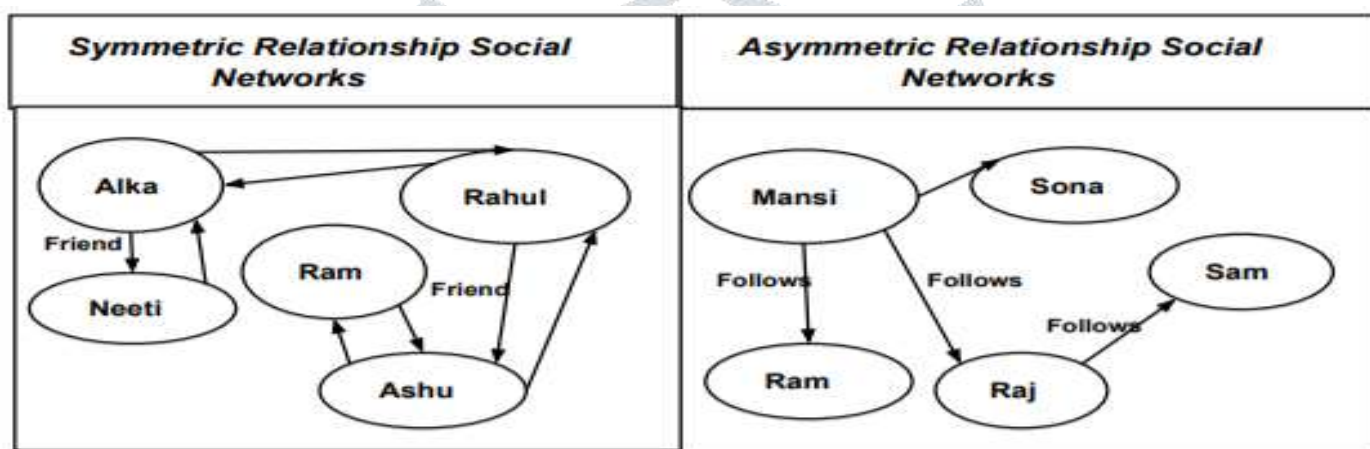


Fig.1. Implicit Social Networks [6]

As in figure 1, two types of networks are being depicted where one is symmetric relationship social networks in which there exists bidirectional relation between two nodes whereas in the other social network that have asymmetric relationship having unidirectional relation between the two nodes. These two networks are a very small example for such types of networks.

II.2. Social Network Analysis

In the current years, there has been huge growth in quantity of users on social media over the web, from 2010 to 2018, the number of users has increased from 0.97 millions to 2.62 millions. So, the social networks have become very significant. In the figure 2, the chart depicts the increasing amount of users. Since the quantity of users have increased so much in few years, the amount of content shared and the information available over the web is also very huge. So the analysis of these social networks has become significant.

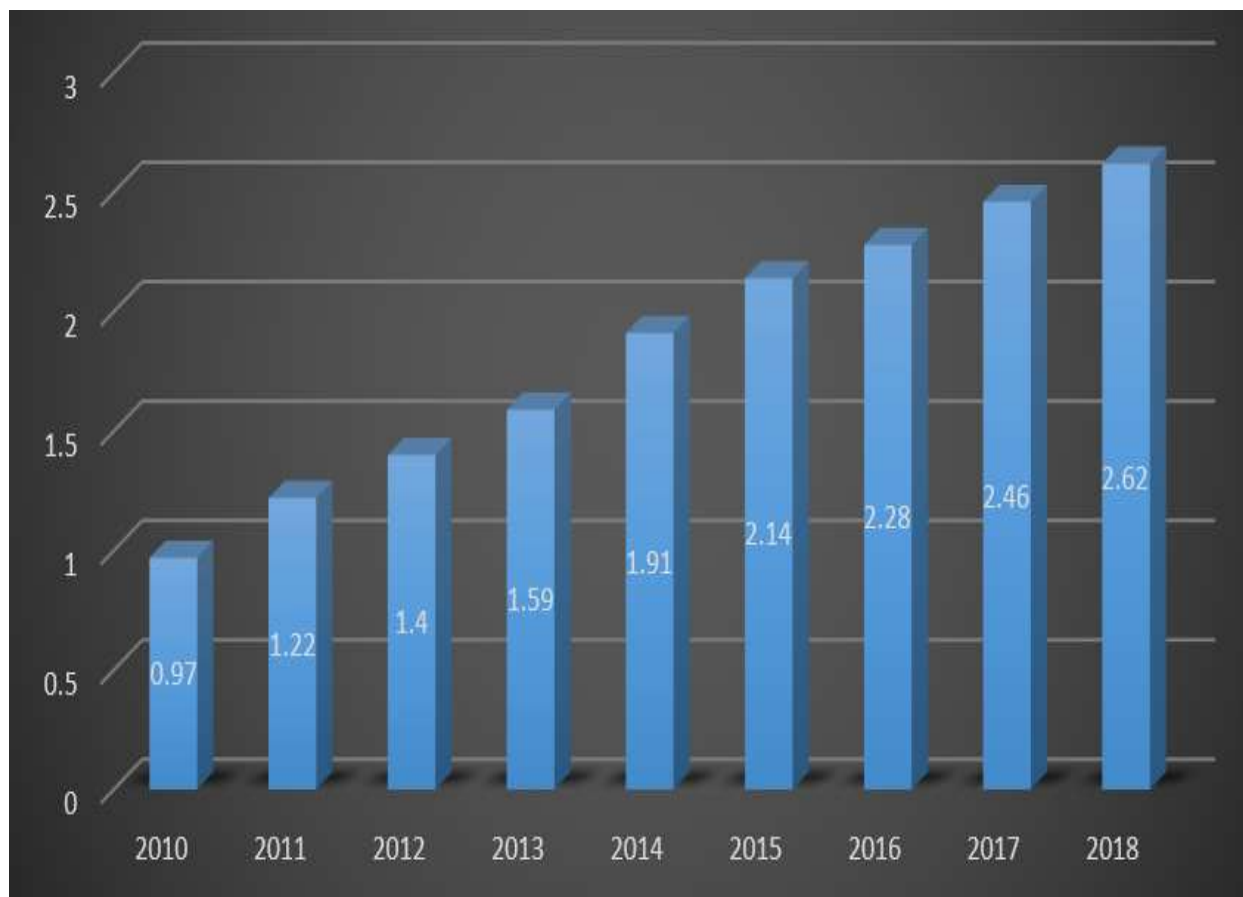


Fig.2. Increasing number of users on social network in last few years

The above figure survey shows clearly that how number of users on social networks are increasing every year.

II. TOOLS FOR SNA

For social network analysis there are various tools such as SocNetV, UCINET, Gephi etc [15][16][17] which provide different properties for the visualization and creation of different social networks in the form of graph or matrix. In this section, a broad overview of several significant available tools for analysis of social networks have been presented with a brief description of each tool[15]. Comparison among different social network analysis tools can be done based on various properties [17]. Some of the tools given below are discussed and their features being presented in a comparative table.

- SocNetV[15] : It is an open source stand-alone software which enables the user to visualize as well as create social networks. It can accept various file formats. For analysis it provides various centrality measures. It is user friendly and provide various centrality measures for analysis.
- UCINET[16] : It is an open source standalone software where user can import different social networks in various file formats. It provides a few visualization layouts. It's version is 6.642.
- Gephi[17] : It is a stand-alone software which requires licence. It provides various centrality measure for analysis of social networks. It's version is 0.7 alpha.
- Pajek[18] : It is a stand-alone open source software with version 1.26.
- Igraph[19] : Use of graphical editors to represent relations and taxonomies. It requires licence and supports various centrality measures. It's version is 0.5.3.
- NetworkX[20] : This software requires licence and its latest version is 0.6.

Table 1. Comparison of Social Network Analysis Tools [6][7]

Comparison Parameters	Features	SocNetV [15] 2.3	UCINET [16] 6.642	Gephi[17] 0.7 alpha	Pajek[18] 1.26	Igraph [19] 0.5.3	NetworkX[20] 0.6
General Description	Type	Stand-alone software	Stand-alone software	Stand-alone software	Stand-alone software	Library	Library
	Availability	Open source	Open source	Required license	Open source	Required license	Required license
Centrality Measures	Degree Centrality	✓	✓	✓	✓	✓	✓
	Betweenness Centrality	✓	✓	✓	✓	✓	✓
	Information Centrality	✓	✓	✓	✓	✓	✓
	Page Rank	✓	✓	✓	X	✓	✓
Types of graph	Two mode graphs	✓	✓	X	✓	✓	✓
	Multi relational graphs	✓	✓	X	✓	X	X
Visualization layouts	Circular	✓	✓	✓	✓	✓	✓
	Spectral	✓	X	✓	✓	✓	X
	Random	✓	X	X	✓	✓	✓
	Spring	✓	X	✓	X	✓	✓

In the table 1, a comparison of various social network analysis tools is being made on four different comparison parameters that are general description, centrality measure, graph types and visualization layouts. Further four different comparison parameters i.e. 'general description', 'type' and 'availability' is being compared. In centrality measures, a comparison has been made between degree centrality, betweenness centrality, information centrality and pagerank. In graph types, two-mode and multi-relational graphs are being compared. Finally in visualization layouts, circular, spectral, random and spring layouts are being compared.

III. A PROPOSED RESEARCH FRAMEWORK FOR SEMANTIC SOCIAL NETWORK ANALYSIS

For the research in the field of semantic social network analysis, there is a need of research frameworks with the help of which the research may be conducted in a more better way. In this regard, figure 3 provides a pictorial view of a research framework proposes three sections. Firstly, the collection of the data present over the web with the help of social networking sites such as facebook, instagram, twitter in the form of either symmetric relationships or asymmetric relationship social network. Secondly, the ontology activities such as social network analysis ontology and social tagging analysis ontology are being analyzed with the aid of SPARQL and it's extensions. Finally, the evaluation and the output have been inferred for social interfaces and applications.

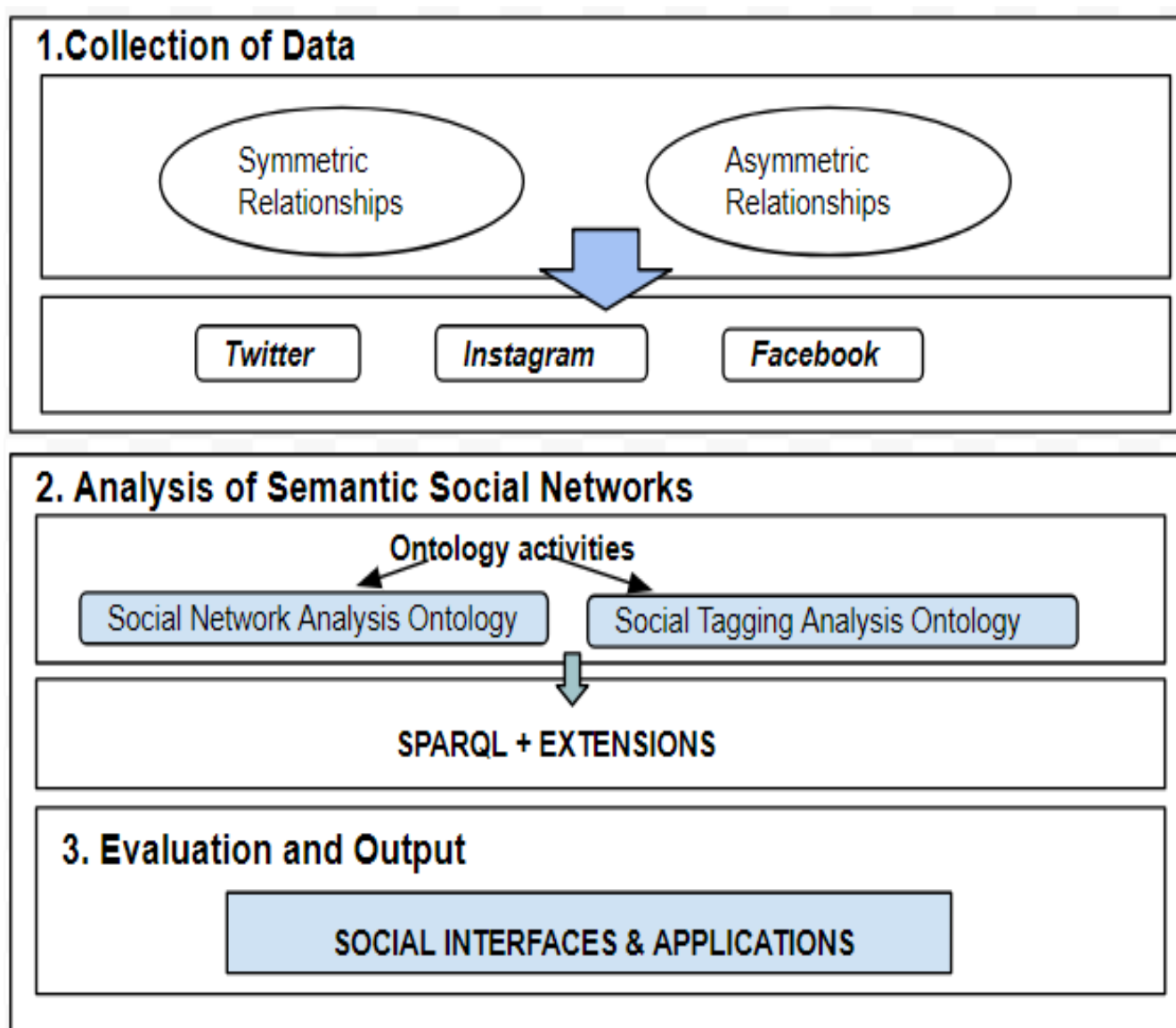


Fig.3. A research framework for semantic social network approach

The first section refers to collection of data which involves symmetric and asymmetric relationships from twitter, facebook, instagram etc. The second section refers to analysis of semantic social networks which involves ontology activities of social network analysis ontology and social tagging analysis ontology. It may be performed with SPARQL and its extensions. The third section refers to evaluation and output involving social interfaces and applications.

4.1 Steps for Research on Semantic Social Network Approach

There are three basic steps for research on semantic social network approach which may aid in analysis of social networks by embedding some semantics to it. These basic steps are as given below:

- ✓ **Processing and collection of data:** In this step, first of all the data have to be collected and it is further processed in a useful data by scrapping out all the useless data.
- ✓ **Analyzing semantic:** After the collection of the data, semantics need to be attached with the data which have to be analyzed to gather the desired output.
- ✓ **Evaluation and recommendation system:** In this step the meaningful data have to be evaluated and further the analysis

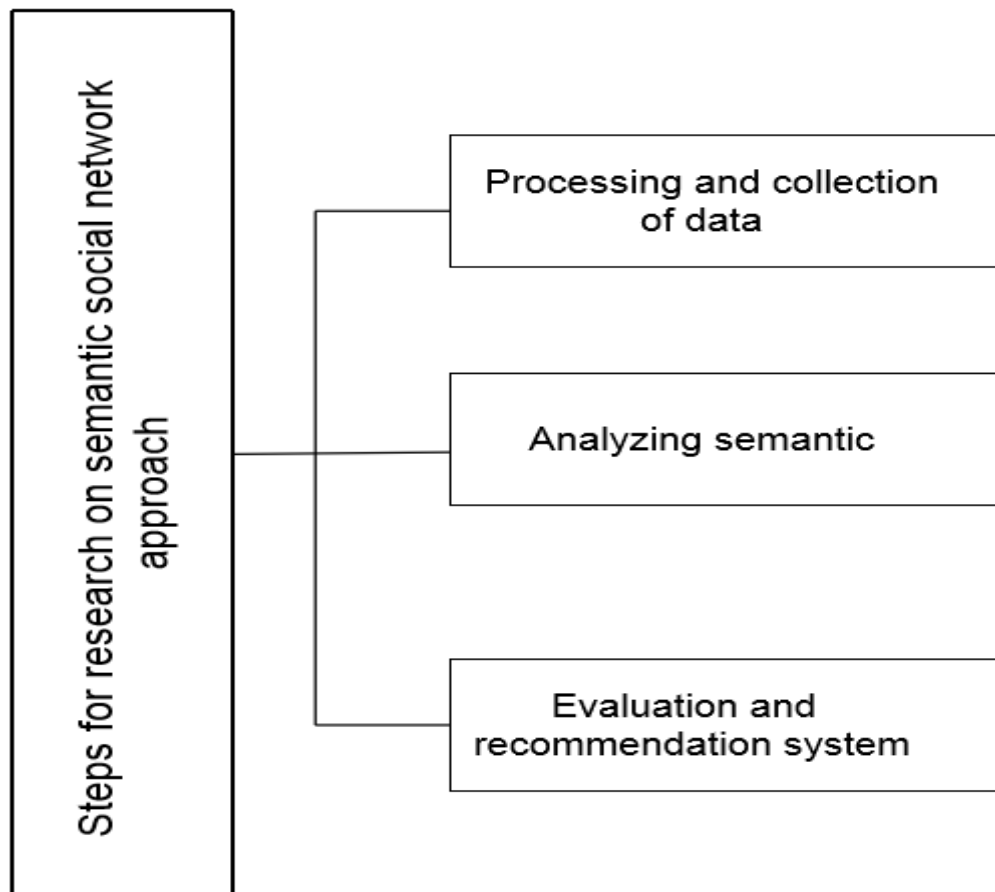


Fig. 4. Steps for research on semantic social network approach

The need is to further explore the research concerns associated with these steps, especially, for analyzing semantic social network analysis.

IV. SEMANTIC SOCIAL NETWORK ANALYSIS AND ITS RESEARCH CONCERNS OF ONTOLOGY AND SPARQL

5.1. Ontology for Social Network Analysis:

Several ontologies are available on the web for the analysis of social networks. There are four principle categories of ontologies for social network analysis. These ontologies may be further classified as in figure 5. The figure depicts the hierarchy of predefined online social network analysis ontologies [18].

These basic ontologies for social networks have various properties or features which are as below:

- **FOAF:** It stands for Friend of A Friend which describes various profile of users and their online account [18].
- **RELATIONSHIP :** It is a specialization of “knows” property of FOAF as it is further used to characterize relationships of user [18].
- **SIOC:** It is Semantically Interlinked Online Communities which specifies the user activities description for FOAF users profile [18].
- **SIOCT:** It is SIOC Types module which further extends the ontologies of SIOC with the help of subclasses [18].
- **SIOCS:** It is a SIOC Services further extends the ontologies of SIOC which allows all the services with the interface [18].
- **SKOS:** It is the Simple Knowledge Organization System which gives a descriptive concept of relationship [18].
- **MOAT:** It is Meaning Of A Tag which describe the meaning of a tag and further specifies the difference between various tags [18].
- **MUTO:** It Modular Unified Tagging Ontology which is an extension of MOAT ontologies [18].
- **WAC:** It is Web Access Control Vocabulary which further specifies list of access control [18].
- **S4AC:** It is Social semantic SPARQL Security for Access Control Ontology that base on WAC [18].
- **AMO:** It is Access Management Ontology which is used for annotating all the resources [18].

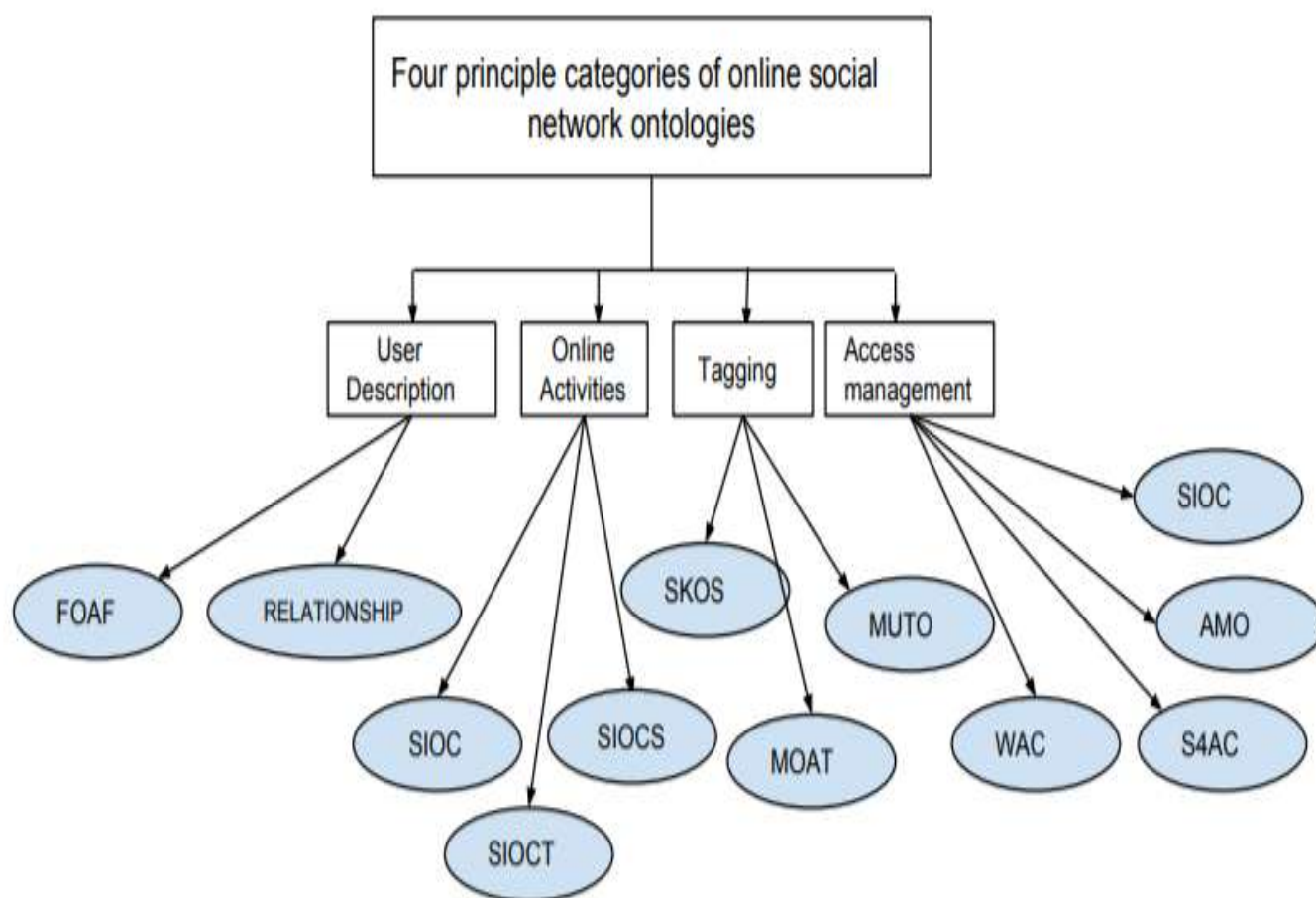


Fig.5. Basic ontologies for social networks

The basic ontologies for social networks are shown in figure 5 which may be divided into various ontologies like user description, online activities, tagging and access management.

5.2. Using SPARQL for Querying and Transformation of Social Networks

In 2009, San Martin et al. did some research which derived that SPARQL is powerful tool to derive sensible information about the networks. The parameterized operators which are defined in SPARQL help in the adjustment of the granularity of the relation and interactions analysis while the classical social network analysis does not considers the semantics of the rich graphs for example RDF.

5.3. Research Concerns of Semantic Social Network Analysis Regarding Ontology and SPARQL

There are various research concerns which are related to social network analysis by embedding some semantics to it by forming RDF graphs and further querying and transforming it with the help of SPARQL. The major research concerns key questions are:

- How to transform online Social Data into ontology-based representation.
- How to further conduct a Semantic Social Network Analysis such that the semantics attached to social data in the form of ontology representation acts as a advantage.
- How the queries of SPARQL manage to extract the desired information from such huge social data.
- How this analysis can affect the current scenario of our social world.

V. CONCLUSION AND FUTURE SCOPE

This paper proposes a research framework for semantic social network analysis to aid other researchers with the steps involved in conducting research in the field of semantic social network analysis. Some of the key questions in concern to research in semantic social network analysis regarding ontology and SPARQL are presented. The idea is to provide an overview of the steps involved while conducting research regarding this field and possibilities of facing various research challenges which needs to be addressed in future. Further, the proposed framework may be enhanced or different frameworks may be proposed. Further, various research issues needs to be dealt in more depth. Literature review regarding semantic social network analysis needs to be

explored further and various research concerns related to it. Various centrality measures and their role may be explored in future with illustrations.

REFERENCES

- [1] T. Berners-Lee: Semantic Web -XML 2000, W3C Web site, 2000 (Last access 11/8/2006). URL: <http://www.w3.org/2000/Talks/1206-xml2k-tbl/slide10-0.html>.
- [2] T. Berners-Lee, J. Hendler, O. Lassila, "The Semantic Web", The Scientific American Magazine, Vol. 5 (1), May 2001 (Last accessed 20/9/2006).
- [3] Nadeem Akhtar, Hira Javed, Geetanjali Sengar, "Analysis of Facebook Social Network", IEEE International Conference on Computational Intelligence and Computer Networks (CICN), 27-29 September, 2013, Mathura, India
- [4] Zelenkauskaitė, Asta, et al. "Interconnectedness of complex systems of internet of things through social network analysis for disaster management." Intelligent Networking and Collaborative Systems (INCoS), 2012 4th International Conference on. IEEE, 2012.
- [5] Li, Jianfeng, Yan Chen, and Yan Lin. "Research on traffic layout based on social network analysis." Education Technology and Computer (ICETC), 2010 2nd International Conference on. Vol. 1. IEEE, 2010.
- [6] Online Social Networks: Measurement, Analysis, and Applications to Distributed Information Systems by Alan E. Mislove, Houston, Texas
- [7] Social Networks Overview: Current Trends and Research Challenges" November 2010 Coordinated by the —NextMEDIA CSA
- [8] Nadeem Akhtar, " Social Network Analysis Tools ", IEEE Fourth International Conference on Communication Systems and Network Technologies, 2014
- [9] International network of Social Network Analysis INSNA www.insna.org
- [10] SocNetV <http://socnetv.org/docs/index.html>
- [11] Visone <http://www.visone.info/html/about.html>
- [12] UCINET <https://sites.google.com/site/ucinetsoftware>
- [13] Gephi <https://gephi.org>
- [14] Cytoscape <http://www.cytoscape.org>
- [15] M. Granovetter. The Strength of Weak Ties. American Journal of Sociology, 78(6), 1973.
- [16] D. Liben-Nowell, J. Novak, R. Kumar, P. Raghavan, and A. Tomkins. Geographic Routing in Social Networks. Proceedings of the National Academy of Sciences (PNAS), 102(33):11623–11628, 2005.
- [17] I. Pool and M. Kochen. Contacts and influence. Social Networks, 1:1–48, 1978.
- [18] M. Girvan and M. E. J. Newman. Community structure in social and biological networks. Proceedings of the National Academy of Sciences (PNAS), 99:7821–7826, 2002.
- [19] Y.-Y. Ahn, S. Han, H. Kwak, S. Moon, and H. Jeong. Analysis of Topological Characteristics of Huge Online Social Networking Services. In Proceedings of the 16th international conference on World Wide Web (WWW'07), Banff, Canada, May 2007.