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Semantic Web in Health Care

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Abstract: Extracting useful information from numerous records stored in medical data structures is particularly difficult. Developed primarily for use in web information systems, web semantic technologies offer efficient solutions for the management of complex and distributed data and can also be used in clinical information. The semantic web provides solutions to encode information in a meaningful way and as a result, records can be searched efficiently and created easily. Semantic web technologies can facilitate the management and sharing of information to promote linguistic competence in healthcare information systems. Technological advances in biomedical engineering and scientific health disciplines have enabled many Health Information Systems (HIS) and medical devices to generate enormous amounts of data. Hospitals produce this data daily and the data produced has diverse sources and is therefore stored in different repositories or databases resulting in limited relevance of HIS data. This article aims to provide an overview of semantic web technologies in health care.

***Index Terms* –Health Information System, Ontologies.**

I. Introduction

Semantics Web technology provides tools that facilitate the handling and exchange of information between systems. Vocabularies define the ideas and relationships (also known as "terms") needed to characterize and represent an area of concern on the Semantic Web. Vocabularies are used to categories the phrases that may be used in each application, identify connections, and establish any limitations on utilizing those words. In practice, vocabularies can be extremely large (with hundreds of thousands of words). [1] There is no apparent distinction between what are called "vocabularies" and "ontologies." The term "ontology" is increasingly being used for more complicated and sometimes formal collections of concepts, whereas "vocabulary" is increasingly being used where rigorous formalism is not required or just in a very loose sense. On the Semantic Web, vocabularies are the fundamental building blocks for inference algorithms.

The formal description of knowledge as a collection of ideas and their interactions is known as ontology. Individuals (cases of objects), classes, properties, connections, constraints, rules, and universes must all be properly specified for such a description to be possible. As a result, ontologies can not only describe quantifiable and reusable information, but they may also add latest information to the domain. [2] The nodes and margins between these nodes represent them and the relationships between them, describing the structure of knowledge in a field, providing a platform for capturing data on the ontology knowledge graph. Health information systems can reduce treatment costs, predict calamities, help prevent disease, and contribute to personal life satisfaction. Recently, significant amounts of different and varied data on health services have emerged from a variety of sources, including patient clinical records, laboratory results, and obsolete devices that make traditional data processing and management difficult.

Healthcare information systems need to adapt to the challenges that lie in the process of health data management, such as scale, speed, and diversity, and use new methods and techniques to manage and process this data to obtain useful information and knowledge. [3] Over the past few years, many organizations and companies have shown an interest in using web-based semantic technologies with broad knowledge in the healthcare industry to turn information into knowledge and intelligence. [4] In hospitals and other medical institutions, the computerization of health systems and technological medical devices in daily basis continue to produce the data obtained from medical records, patient monitoring and medical imaging. This explosive growth of valuable information is to be valuable to valuable information and to properly discover the valuable knowledge of data that can result in the development of healthcare principles and superior products. Nevertheless, this main goal is continuing the terrible task because of many problems. [5]

II. Semantic Web Architecture

The Internet is being used to find information. Websites are searched using popular search engines such as Google. [6] Users type in some keywords that indicate the information they are looking for and the search engine returns the most popular web pages that contain the information the user is looking for. Search engines display the indexes they have created so far on all web pages on the Internet. Search results are always ranked lowest in the list of relevant pages. But consumers want to see these products and see the statistics that apply on the first page. [7] And this process is extremely complicated and time consuming for many users, and now fails due to the choice of keywords. Figure 1 shows a diagram of the semantic web architecture.

URI and Unicode layer: This layer provides a straightforward and protractile means for distinguishing resources. A resource is often something that has an identity like an internet website, a document, a picture, and an individual. Unicode is considered because of the universal commonplace encryption system for pc character illustration. Most encryption systems represent solely a few languages whereas Unicode represents all languages. [8]
XML layer: This layer describes what is within the document, not what the documents sound like, whereas XML Schema provides grammars for legal XML documents.
Data interchange and RDF layer: This layer uses URIs to spot web resources and uses a graph model for the aim of describing the connection between completely different resources. [9] RDF Schema could be a straightforward modeling language introducing categories of resources, properties, and relations between them.
Ontology (OWL), question (SPAQL), RDF-S, and RIF layer: the most important objective of metaphysics is to supply semantics that produces an internet of which means. Ontologies can facilitate machines to method the which means and facilitate sharing of knowledge. [10] RIF (Rule Interchange Format) specifies the XML format for rules at an intermediate communicatory power compatible with RDF and hooter in line with what is written by the RIF social unit.
Unifying Logic layer: This layer provides the muse for combining the on top of 2 layers' technologies into an entire, with a unifying language to interact queries and rules over data depicted in RDF and associated ontologies and schemata.[11]
Proof layer: This layer is employed for checking the validity of specific statements.
Trust layer: It is speculated to give a mechanism for trust and confidence between info sources and parities.
Program and Applications layer: This layer deploys as a baseline that everyone user interface and applications ought to satisfy.
Vertical layers: Crypto layers measure coding and Digital Signature. [12] The layer starts from layer one up to layer half-dozen.
Digital signature: This could be a step towards an internet of trust. By victimization AN XML digital signature, any digital info is often signed. [13] There square measure specific components in XML syntax used for this method like Signed Info, Reference, and Digest Value. XML Signatures are often applied to the content of resources and in this manner, each resource is often known.[14]

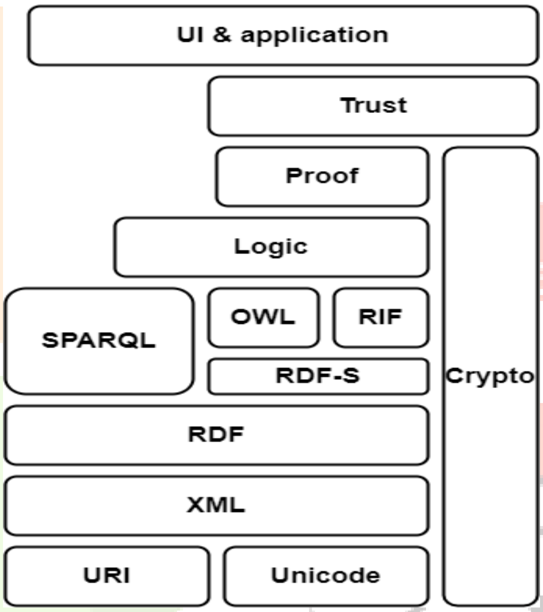

Figure 1. Semantic Web Architecture [15]

III. ONTOLOGY EDITORS

The ability to communicate amongst information systems is one of the most challenging tasks in healthcare. Interoperability is crucial because it makes information transfer easier in a complex setting. When paper-based medical records were preserved in folders, there existed a plethora of useful information that had no relation to one another. [16] One of the most important characteristics of ontologies is that they enable automated data reasoning by including the crucial links between concepts. In semantic graph databases that employ ontologies as their semantic schemata, such reasoning is simple to implement. All databases with all data formats such as structured data (e.g., surgical reports, radiology, and pathology), unstructured data (e.g., medications, laboratory results), and visual data (e.g., radiological images) [17] were integrated in the healthcare organization by computerizing them in the form of an electronic medical record.
The interactions between these powerful structures are complex and require an information exchange approach. SW uses an ontology to create common language and compatibility standards.[18] Some of this ontology is listed in Table 1. These It is a general compatibility standard and healthcare terminology that can facilitate access to essential information by increasing the accuracy of web searches.[19] Specifically, in research, researchers face problems such as polysemy, ambiguity, and synonyms that increase and publish results.

Ontology Editors

Name	Purpose
Arden Syntax	A standard for representing medical knowledge
ICD-10	A classification for diagnostic codes.
CPT	A classification for diagnostic and surgical procedure codes.
LOINC	A general database for labs code and name, and clinical examinations.
GALLEN	Uses the language for displaying treatment terminology.
UMLS	Facilitates the retrieval and integration of information from a variety of sources and is used as a basic ontology in medicine.
SNOWMED	A reference terminology.
LinkBase	Facilitates the modeling of ribosome components and compares the results of the studies.
Gene Ontology	To display information about the role of genes produced by an organism
Riboweb Ontology	This system presents medical terminology by algorithms in an official domain ontology.

Table 1. Feature summary of few representative ontologies in the healthcare domain [20]

These ontologies add context to the patient's medical history, automatically creating a link between diagnostic and therapeutic procedures, laboratory tests, and X-rays. This makes queries more efficient and results closer to search terms. Semantics Web provides a common framework for the exchange and reuse of knowledge between programs and organizations. [21] This exchange and re-use of knowledge improves research by generating innovative ideas, testing different hypotheses from various aspects, facilitating the training of researchers at an early stage, and reducing the cost of gathering information. [22]

IV. Limitations and Challenges

While ontologies offer a diverse range of tools for data modelling, their usefulness has several drawbacks.

1. While the most recent version of the Web Ontology Language - OWL2 has a rich collection of class constructions, it has a restricted collection of property capabilities.
2. The content's accessibility. There is currently a scarcity of Semantic Web content. Current online material, such as static HTML pages, existing XML material, dynamic material, multimedia, and web services, should be updated to Semantic Web content. [23]
3. Another problem occurs from OWL's use of restrictions. They are used to indicate how data should be formatted and to prohibit data from being added that does not comply with these restrictions. [24] This, however, is not necessarily a good thing. Data imported from a new source into the RDF triple store is frequently structurally incompatible with OWL restrictions.
4. It will take a large amount of work to organise Semantic Web material, store it, and give the tools to discover it. All these activities must be completed and coordinated in a scalable manner, since these solutions must be ready for the Semantic Web's massive expansion. [25]

V. Conclusion

The Semantic web has gained popularity as a platform for information integration and analysis in the health domain. In the medical science, information sharing is critical since most of the accessible medical data requires a way to be exchanged across several computer systems. Ontology-based interoperation is meant for sharing knowledge and transferring information between individuals as well as between services/applications, and it includes fields such as mobile communications and so on. Ontologies may be used to search for context-based medical research material, integrate it, and utilize it as a foundation for future research, as well as to create context-based regulations for appointments, procedures, and testing to enhance healthcare quality.

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