BioGecko
Vol 12 Issue 03 2023
ISSN NO: 2230-5807

Query Suggestions with Medical Data Formulation using Ontology

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Abstract**—**In order to provide self - directed suggestions and oriented data that can be properly analysed, recommendation system is becoming more and more crucial to both individual users and healthcare businesses. An innovative patient-centric framework is the proposed system.The patient's medical history is deleted and kept on servers that are only partially trusted.The PHR files for each patient are encrypted using Attribute-Based Encryption (ABE) mechanisms in the proposed approach.This encryption method offers secure and confidential data access. In contrast to earlier efforts, this one focuses on the scenario of numerous data owners and divides the users of the patient health information system into various security domains, greatly reducing the complexity of key management for both clients and users.The dataset that is acquired and the unclear qualities nearly always have a significant impact on the feature selection and data categorization processes.

Index Terms**—recommender systems, encryption, ontology, feature selection, encryption.**

I. Introduction

Prospective Information retrieval techniques used in information management systems include structured query formulation languages. The creation of structured queries, which let end users build sophisticated database queries by knowing specialised query languages, is a potent method of data retrieval. With the exception of a few visual query formulation and refinement technologies, users of various system levels still find it very difficult to formulate queries [1]. Due to the greater usage of business analytics, decision support, and data mining applications, information retrieval has grown more difficult in recent years. With time, the amount of data from the Web grows, further enhancing search solutions for online consumers. Naturally, searchers prefer to post their questions in their mother tongues, yet computers frequently struggle to fully understand these human languages. Using keywords instead of real language to approximate users' information demands is an easy and straightforward technique to build user questions. Then, search engines handle keyword queries in a Boolean manner, meaning that each document is considered as a set element, and querying a keyword retrieves a set of documents that are pertinent to the basic keywords. Following that, sets of documents are subjected to Boolean operations, such as AND, OR and NOT to return the best combination of (potentially ranked) documents as outcomes. Unfortunately, none of the advancements in search services up to this point, as far as we are aware, have been able to fully match the search abilities of a technology is rapidly, such as a librarian, who effectively and strategically retrieves particular data pieces from a vast array of resources [2].

In an effort to improve search results using automated search services, Batesresearched the human search approach in 1979 and created a list of strategies employed by librarians in information retrieval [3]. This fact is particularly evident in the healthcare industry, where the use of healthcare data can produce enormous volumes of high velocity data that frequently need to be evaluated in real-time to make patient-related choices like diagnosis, treatment plans, prescription of medications, etc. Additionally, as the emphasis on holistic treatment approaches grows, healthcare professionals need patient data from several health domains in order to make wise judgments. One such instance is the health and dental professions. Strong correlations between medical and dental health disorders have been frequently demonstrated by research, which has emphasized the importance of analyzing patient data from both domains when deciding on a diagnosis and course of therapy.

However, there isn't much in the way of technical advancement that can offer the right computer environment for data analysis and decision support based on shared and interrelated information from the healthcare and dental areas of medicine. As a result, the data can be analyzed to derive useful advantages including reusability and decision assistance features like warnings, suggestions, reminders, and explanations. Practitioners might be unable to take advantage of the abundance of knowledge that is included in the material in the absence of effective and automated analysis [4]. As a result, they can miss the information or be unable to anticipate hazards that could result from interactions between already-existing illnesses. The intricacy of Big Data must therefore be handled by approaches and technologies if useful information is to be extracted from it in a pertinent, timely, and accurate manner. The issues raised above can be resolved in two ways: either by improving user queries or by optimizing the search engine in the hopes that it will return accurate results regardless of what user input is. Contrary of the latter approach, this work is oriented to concentrate on improving the user queries [5].

Due to their shared ideas and semantic interoperability, ontologies are used to simplify dimensional design by assisting in the discovery of business entities and their relationships as well as the identification of prospective facts and dimensions from each data source. Knowledge from a domain ontology is retrieved and transferred into a star schema or dimensional cube once each local ontology has been aligned, according to works [22] . A conceptual framework known as the software development life cycle outlines the duties that must be carried out at each stage. Its goal is to deliver top-notch software. There are several different methodologies that are utilized throughout the software development lifecycle. Yet, every development life cycle approach contains a set of procedures known as verification and validation [23]. To comprehend all the syntactic data produced by numerous devices and sensors in the Internet of Things, an ontology mapping process should be carried out. Integration with various ontologies is also required because not all devices and sensors can be defined by a single ontology. To align all ontologies with the same semantic vocabulary as part of the ontology integration process, a matching method must first be used to align the ontologies [25].

Unsurprisingly, users might be instructed to create more understandable search phrases before beginning a search procedure. By creating query languages like database queries in SQL, knowledge-based querying in SPARQL which are structured query processing works in this direction. However, end users, particularly web users in general, who pose brief and unstructured questions, suffer tremendous challenge in exploiting the query language to generate keyword queries. When user requests with a few arbitrary terms appear, the issue is how to rephrase them so that search engines can process them. This paper discusses query expansion (QE) tool for expanding the query to include more pertinent search terms for better retrieval results.

II. Related Work

An electronic health records (EHRs) are the original records of the entire diagnosis and treatment of patients, and they can significantly increase work efficiency, elevate the standard of medical care, and enhance patient care.Medical knowledge inquiries and answers, medicine recommendations, and other research investigations have been prioritized as the building of medical information has become more in-depth [2].ontologies can be utilized for query formulation and semantic reconciliation in large distributed information environments. It introduces a Java tool that may be used to build ontology-based queries, browse ontologies, and both. Large ontologies, which are typical of vast information environments, may be managed by users thanks to the tool's incorporation of a number of abstraction mechanisms. The tool is being used in a healthcare administration information system that includes hospitals, clinics, and public health agencies.

One of the key advantages of using domain ontology is the ability to create a semantic description of the information and the related domain knowledge. Links between various kinds of semantic knowledge can be defined using ontologies.Ontologies can therefore be utilized to create various data searching strategies. Many ontologies development and query languages have been created over the last few years, and work on them is still ongoing. The choice of the ontology language to utilize in a particular situation must be made before beginning to create an ontology-based system. In recent years, many ontology languages have been created. The majority of these are machine interpretable [6] since they are built on the eXtensible Markup Language (XML) [7]. Searching for information in databases is known as database information retrieval.

The vastly increased volume of structured and unstructured information included in information sources has increased the demand for efficient solutions to automate information retrieval. Many visual information retrieval techniques have developed over time with the goal of minimizing the end user's effort when dealing with databases. These strategies aim to use visual tools to retrieve data from databases. Form-based [8], query by example (QBE) [9], or query by template (QBT) [10] are a few examples of these methods. Because the tabular structure of the database and the tabular structures used in query interfaces fit well together, these approaches are effective for basic database schema queries.

However, such methods do not aid in semantic retrieving data or offer any assistance with query formulation to produce sophisticated inquiries. To develop interactive database-specific queries, the TAMBIS system [11] provides the specialization or generalization of the base or filler ontology concepts. Here, ontology concept instances are stored (connected) as data in the databases.This method can be used to tackle integration issues when every information source has the same schema or offers a very similar perspective of a given domain. In GRQL [12] and KnowledgeSifter [13], another comparable method based on ontological graph pattern searches, is provided. The ideas for designing and creating an ontology-based query interface are described in SEWASIE (SEmantic Webs and AgentS in Integrated Economies) [14].Using pre-stored domain knowledge, OntoQF [15] uses OWL-DL ontologies to automatically generate relational database queries for information retrieval.

One of the key differences between OntoQF and other existing techniques is that it combines database-toontology translation and mappings to enable automatic query formulation, which aids in producing accurate database queries. Ontogator [16], OntoViews [17], and other ontology-based image retrieval systems are examples of concept-based multi-facet searches that use RDFS ontologies as their foundation.Multiple unique views are added to the data produced by ontology projection in a multi-facet search.Semantic auto-completion of a query is supported by Onto Views. This paper examines ontology-based information retrieval techniques while taking into account the creation of ontologies from database schema and the transformation of domain knowledge into ontological knowledge

For the infrastructures of semantic sensor webs, Raul et al. [18] have described the essential ontological model. A common set of requirements linked to modeling domain-specific aspects of interest and properties are satisfied by the approach, which involves integration and evaluation of numerous domain-specific ontologies. These recommendations are followed during the building of the ontological model.

By registering several domain-specific ontologies, Nagai et al[19] . Semantic-based method to data interoperability among distinct companies creates a semantic media wiki. The compatibility of earth observation data with ontology registry is the main focus of this strategy. The reference data needed for the retrieval of earth observation data is provided by registered ontologies. In order of importance, the reverse dictionary returns highly relevant technical terms. When a system is either not yet defined or available or cannot be directly used owing to cost, time, resource, or risk constraints, verification through analysis is appropriate [24]. For the first time, an intelligent transformer failure diagnosis method using fuzzy ontology reasoning is used in a multi-agent context. [26].

An automatic extract, transform, and load (ETL) method for integrating Ocean data is described by Dong-mei et al. in [20]. The method consists of four steps. 1) Take data semantics and structure out of the source datasets 2) match the destination database with the source data sets. 3) takes into account the destination database's data formats and semantics. 4) Import the desired database's data. Using this method, the target database is integrated with source datasets in a variety of data formats.

III. Proposed Methodology

The proposed framework for query suggestion is shown in Figure 1.The most crucial modelling tool is the data flow diagram (DFD).The system's component models are created using it.These elements include the system's operation, the data it uses, a third party that engages with it, and the way information moves through it.DFD shows the system's information flow and the numerous modifications that have an impact on it.It is a graphical way of illustrating how data is altered as it moves from input to output.Any degree of abstraction that can be broken down into stages that corresponds to increasing levels of functional complexities and information flow is known as a DFD. It is a straightforward graphical formalism that may be used to depict a system in terms of the data that is fed into it, the different operations that are performed on it, and the data that is produced as a result of those operations.

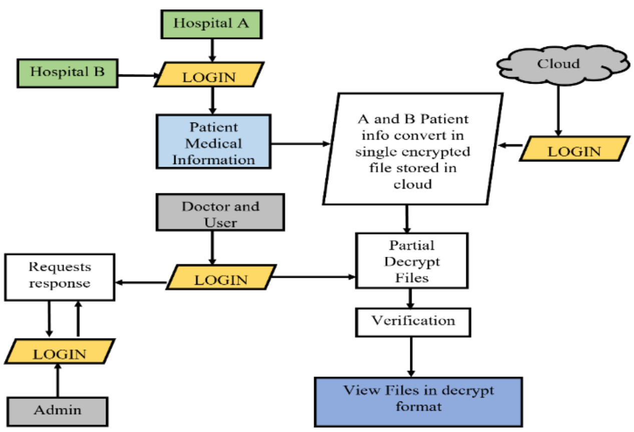

Figure 1. Proposed QE Framework

A class representation in the Unified Modelling Language (UML) is a type of static structural diagram used in application development that shows the classes, attributes, activities, and relationships between the classes to show how a system is organised. It describes the type of information that is present. The procedures of sequential steps with flexibility for choice, iteration, and concurrency are depicted graphically in Figure 2.Activity representation is used to depict the operational and business workflows of system components in UML. An activity diagram demonstrates the total control flow. Figure 3 shows the workflow of proposed method. The terms were examined for lexical and syntactic parallels and contrasts. A more generic and a more particular term were derived from each term by further refining it.By doing so, more terms were found and a preliminary hierarchy was established. The associations found in the literature were used to further identify neighbourhood phrases. The key research issue in this phase was to find every term that could possibly convey the depth of both areas while also ensuring that every term was pertinent to both domains.In order to prevent the ontology from becoming cluttered with unnecessary and irrelevant information, these two requirements made sure that only necessary concepts were modelled in it.

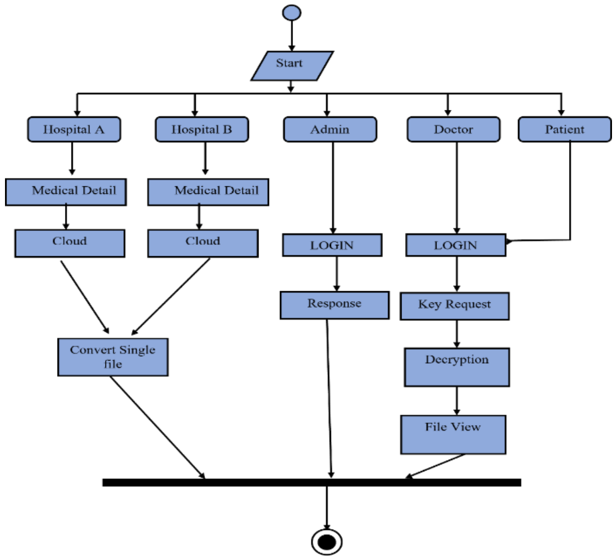

Figure 2. Flowchart of proposed QE.

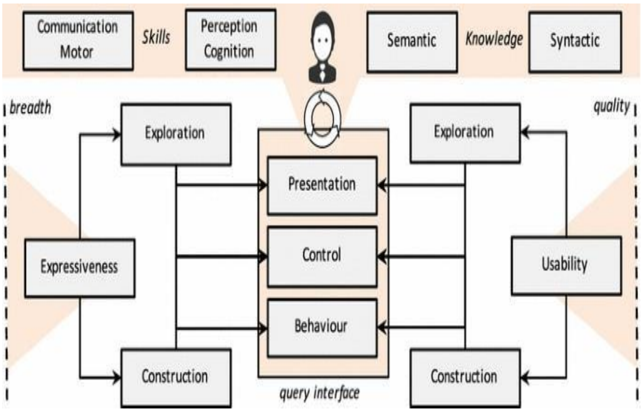

Figure 3. Workflow of patient centric framework.

IV. Results and Discussion

The datasets used for training is shown in Figure 4. Three basic classes—patient, procedure, and clinical condition—along with some of their subclasses can be seen. For the patient class, there are also a few associations (described as object attributes). To connect the interdependent circumstances and consequently integrate the medical and dental care domains within the ontology, the attributes have been modelled in accordance with the use cases.

#	Name	Type	Collation	Attributes	Null	Default	Extra
1	doc_info	varchar(45)	latin1_swedish_ci		No	None	
2	file	longblob			No	None	
3	time	varchar(45)	latin1_swedish_ci		No	None	
4	patient_info	varchar(45)	latin1_swedish_ci		No	None	
5	patient_id	varchar(45)	latin1_swedish_ci		No	None	
6	pname	varchar(45)	latin1_swedish_ci		No	None	
7	gender	varchar(45)	latin1_swedish_ci		No	None	
8	age	varchar(45)	latin1_swedish_ci		No	None	
9	pdob	varchar(45)	latin1_swedish_ci		No	None	
10	pmail	varchar(45)	latin1_swedish_ci		No	None	
11	doctor_info	varchar(45)	latin1_swedish_ci		No	None	
12	doctor_id	varchar(45)	latin1_swedish_ci		No	None	
13	doctor_name	varchar(45)	latin1_swedish_ci		No	None	
14	poci	longtext	latin1_swedish_ci		No	None	
15	rfv	longtext	latin1_swedish_ci		No	None	
16	medications	longtext	latin1_swedish_ci		No	None	
17	immunizations	longtext	latin1_swedish_ci		No	None	
18	spatient_info	varchar(45)	latin1_swedish_ci		No	None	
19	spatient_id	varchar(45)	latin1_swedish_ci		No	None	
20	spname	varchar(45)	latin1_swedish_ci		No	None	

Figure 4. Dataset used in proposed framework.

'Hospital' can be handled in any method, depending on the situation and the level of detail of the data that must be modelled. For instance, 'hospital' can be handled as class with different hospitals as its subclasses or people if it is necessary to represent individual hospital wards.By embracing contextual modelling, punning not only improves the ontology's expressivity but also its capacity to communicate with other ontologies that might have modelled identical concept in a different way. Figure 5 and Figure 6 shows the screenshots of results based on proposed ontological based query suggestions for patient and medical records.

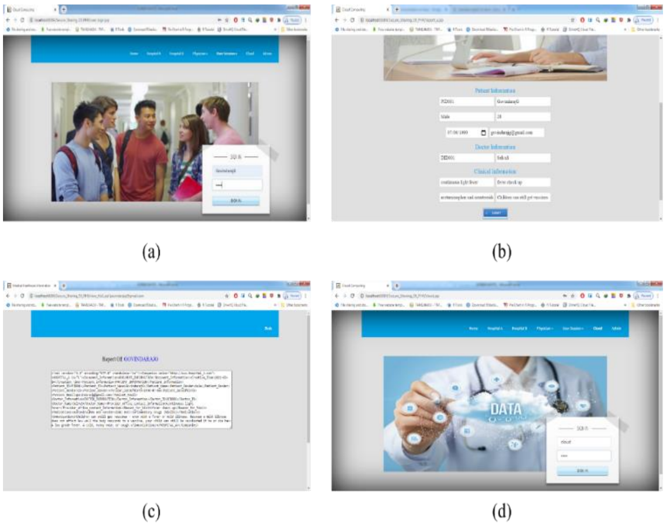

Figure 5. Screenshots of portal designed for patients linked with hospital. (a) Login. (b) Medical information. (c) XML Encrypted Medical Information. (d) Cloud database access.

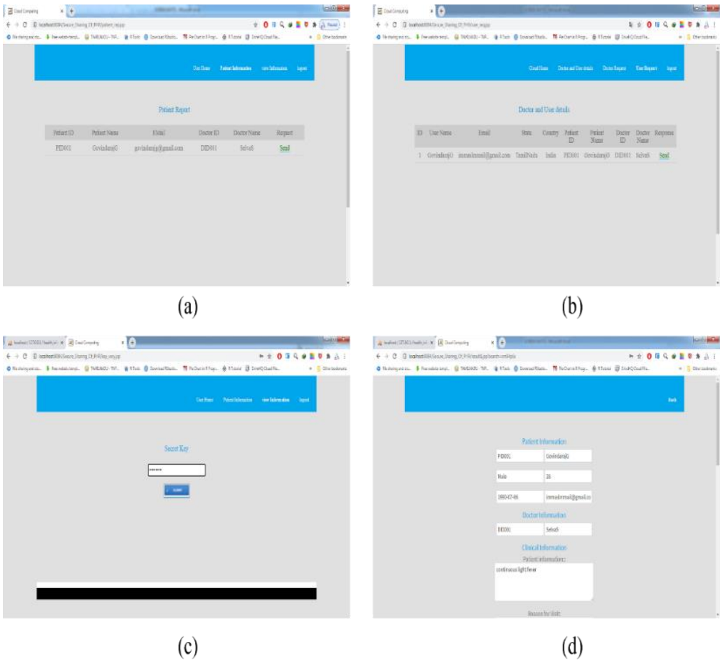

Figure 6.Screenshots of portal designed for physicians linked with hospital. (a) Login. (b) Patient's information. (c) Secret access for viewing patient's information.(d) Patient's access to hospitals.

In the existing techniques Contextual information will be extracted and classified to implement the healthcare services using the context information model. The healthcare context information model can be defined using the ontology, and a common healthcare model will be developed by considering medical references and service environments. Application and healthcare service developers can use the sensed information in various environments by authoring device- and space-specific ontologies based on this common ontology[27]. This proposed technique and ontological based query suggestionsused to keep Patient's information, Secret access for viewing patient's information and Patient's access to hospitals.

V. Conclusion

Despite the potential solutions that ontology in patient records monitoring has to offer, it is constrained in many ways from realising its full potential. Security and privacy issues top the list of these challenges that prevent ontology from being used in healthcare. One of the important research gaps is to develop query suggestions based on ontology. As a result, this research makes use of layered, modular, data-centric cryptography techniques, such as OLE, which make use of secure HI sharing and storing mechanisms. The comparative results demonstrate that this strategy performs better than other widely-used methods (based on several performance parameters) in the context of ontology. The suggested method is currently only intended for the encrypting and decrypting of textual data; it does not yet consider the image-oriented data set. However, this aspect would be taken into account in further development. Second, layered modelling could occasionally lead to a decrease in system performance. By incorporating quantum theory into the proposed work, its effectiveness will be increased and it will be better suited for integrating with smart devices. In the future, we might use the blockchain security framework to protect patients' privacy.

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ISSN NO: 2230-5807

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