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Enrichment of Human Health Information Using Ontology Based Geospatial Semantic Query Processing

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ABSTRACT

With the developing measure of health data and continuous episodes of sicknesses, the recovery of health information is given a ton of concern. Machine understanding of spatial data will enhance the interpretation of health data semantics. The greater part of this investigation focused on the non-spatial semantics of health data, utilizing ontology and standards. Using the spatial component of health data will help inside the understanding of health marvels. This investigation proposes a semantic health data query engineering that empowers the consolidation of each non-spatial semantics and geospatial semantics in health data incorporation and recovery. We tend to expect to give a center layer between ontology storehouses and semantically commented on databases to help semantic queries specifically inside the databases with informative standard database query languages. We have built up a semantic query engine that has semantic reasoning and query process, and translates the queries into ontology repository tasks. Semantic administrators are upheld inside the database as client sketched out capacities reached out to the database engine, so semantic queries is straightforwardly determined in standard database query languages like SQL and XQuery. The framework gives storing administration to supports query execution.

Keywords : Medical knowledge bases, Semantic Web reasoning, Analogical reasoning, Web GIS, Internet, Public Health, Ontology, Respiratory Diseases, Geospatial Data, Semantic Interoperability

I. INTRODUCTION

Both government and private segment associations are looking for approaches to keep up and enhance the health of general society in the world to control the costs in the meantime. For this point internet and utilization of geo referenced public health data for Geographic Information System application is an essential and energizing improvement for the country's Department of Health and Human Administrations and other health organizations. Innovative advance towards general health geospatial information joining, examination, and perception of space-time events utilizing the Internet forecasts possible strong utilization of Geographic Data Framework by general health and different parts of the economy. Expanding Web assets from disseminated spatial information entries and worldwide geospatial libraries, and a developing suite of Web reconciliation devices, will give new chances to advance disease surveillance, control and anticipation, and protect public access and community empowerment in public health decision making.

II. BENEFITS OF (WEB-BASED) GIS

The emotional increment in new diseases, for example, Extreme Intense Respiratory Disorder (EIRD) and the danger of different illnesses, for example, drug-resistant tuberculosis, joined with expanded cross- jurisdiction trade and travel give chances to infections to spread crosswise borders at alarming speed. GIS is rising as a groundbreaking innovation for early ailment location and for fitting and convenient reactions to disease outbreaks. GIS empowers the combination of reliant information from various sources, and backings mapping and spatial examination for basic leadership. GIS, remote detecting, and worldwide situating framework advances have all been progressively connected to health applications. The utilization of GIS innovation can illuminate health authorities and the public about developing health dangers, and help their basic leadership at all levels. Health data identified with socioeconomics, meteorological conditions, authoritative limits, remove from patient to doctor's facilities/centers, and sickness vectors (cultivate creatures, transient winged creatures, and water wells) all might be imagined. GIS is very appropriate for examining epidemiological information, uncovering patterns and interrelationships that would be hard to find in unthinkable arrangements. In this way, conditions and connections between factors that might not have been before hand considered can be uncovered. GIS has been connected broadly in health research, for example, chronic respiratory symptoms, air contamination grimness/mortality patterns, drinking water quality, road transportation arranging, doctor's facility availability designs, disease clusters, health care planning, and climate change impacts.

The key advantages of GIS are recognized underneath.

a. GIS mapping can indicate disease predominance crosswise over geographical territories, empowering lobbyists to look for assets and assets for enhanced health care and oversee flood sought after.
b. GIS benefits health experts and the public by expanding familiarity with the spread of transferable diseases (e.g., avian flu, treatment resistant tuberculosis), and conceivable hazard factor stratification.
c. Disease reconnaissance with GIS can help health authorities to screen diseases after some time and plan inoculation systems.
d. GIS can be utilized to evaluate health office and asset dissemination, give ideal answer for health access, and adjust the requirements and expenses.
e. GIS can represent health information at different scales, from an extremely neighborhood scale to commonplace, national, and worldwide scales.
f. Executing GIS in health establishments is financially perceptive from both disease counteractive action and health advancement perspectives.

Disease recognition at early states is imperative for health authorities to take compelling counter measures to control the spread of disease. Online GIS innovation can support this by giving speedy access to appropriated information for examination, perception, arranging, and demonstrating. Since the reaction of Online GIS is in close constant, it is powerful to understand disease wonders to help basic leadership. Open doors for utilizing health observing/ observation are currently being offered by means of Online GIS applications.

OBJECTIVES

a. The primary target of this examination is to build up a health GIS data sharing engineering and portrayal model to permit the wide access and breaking point the misunderstanding of health data. This exploration centers on tackling the recognized three issues to propel health data sharing. To accomplish this goal, the accompanying sub-targets are distinguished:

b. Outline design by utilizing SOA and SDI for health information mapping and sharing.
c. Create execution assessment measurements to quantify SDI viability and construct trust of SDIs for health applications.
d. Construct a health data portrayal model to share and trade basic health measurable data.
e. Construct a health GIS metaphysics structure empowering both geospatial and non-spatial thinking in health information incorporation and query.

This exploration will make an inexactly coupled and interoperable health data sharing design, break down the adequacy of SDI identified with health examines, create a health data portrayal display, and join the geospatial semantics in administer thinking in the Semantic Web.

HEALTH APPLICATIONS USING (WEB-BASED) GIS

GIS can be utilized to break down public health mind parameters, give basic data in an opportune way, bolster health mind arrangement advancement, screen climatic occasions, organize medicinal reaction measures, and instruct leaders and the overall population. The information utilized in these applications cover the health, ecological, and financial sources. Basic information incorporate healing facility and crisis room confirmations, emergency vehicle databases, patients' area at the season of occurrences, combined encompassing focuses got from air-checking and climate stations, poll overview and meeting information, clinic staff information, remote detecting pictures (used to separate land cover), groundwater-surface water hydrologic transitions and water quality information, statistic measurements, and monetary vectors. The primary classifications of health GIS applications are talked about in the accompanying subsections

DISEASE PATTERN DETECTION

Disease patterns are important to health practitioners in the investigation of disease outbreaks over space and time. Mapping the populations at risk is widely used to show the geographical distribution and variation of illness.GIS can illustrate health events at multiple scales, from a community level to regional, provincial, national, and international levels. As disease phenomena have no boundaries, disease pattern detection should not be constrained to administrative boundaries. Time information can also be incorporated in GIS to study the spatial and temporal trends in disease prevalence. Using spatial statistics methods with GIS to detect spatial clusters and spatio temporal clusters helps the identification of excess or unusual disease occurrences.

DISEASE MONITORING AND SURVEILLANCE

Health researchers who perform disease observing and observation need to comprehend the impact of disease operators in the reason for diseases. To help depict the nearness and circulation of disease operators (physical, synthetic, or natural), GIS has been utilized to recognize wellsprings of these specialists, and in this manner screen the earth with a specific end goal to distinguish the nearness of these operators. Spatial investigation, together with univariate examination, multivariate examination, strategic relapse, and likelihood models is generally utilized in demonstrating danger introduction, chance appraisal, disease spread, and health result. GIS can likewise incorporate different geo referenced sources to decide the relationship between disease manifestations and air contamination, meteorological factors (temperature, relative stickiness, and so forth.), water quality, or financial elements. For instance, a few examinations researched the connection between interminable respiratory indications and long haul surrounding convergences of fine particulates, add up to suspended particulates, ozone, and sulfur dioxide among occupants who are near real roads.

III. LITERATURE SURVEY

SEMANTICALLY ENHANCED IR

The concentration is to recover and locate the most valuable and pertinent on the World Wide Web. The test is to conquer the confinements of conventional watchword based hunt show. A semantic pursuit beats the restrictions of over-burden and confound related with catchphrase-based inquiry. A semantic hunt utilizes metaphysics and bunching calculation to perform significant and profitable recovery of web reports. This approach is an endeavor to enhance the data recovery process utilizing semantic pursuit. Its point is to locate the most valuable data from the immense measure of information accessible on the World Wide Web. Semantic hunt enhances precision by understanding searcher meaning and the logical significance of terms. It utilizes the preprocessing and record bunching for semantic data recovery.

SEMANTIC GRAPH MAPPING

This paper discusses the method for summarizing g document by creating a semantic graph of the original document. Then it approaches to finding the substructure of such a graph that can be used to extract sentences for a document summary. The processes first start with a syntactic analysis (deep) of the document and then for each sentence, extract logical form triples, subject–predicate object from text. Then it applies themes like semantic normalization, co reference solution and cross sentence pronoun resolution to refine the set of triples. After it merges them in to a semantic graph. This procedure is applied to both documents and corresponding summary extracts of it. They train Support Vector Machine on the logical form triples to learn the automatic creation of document summaries.

SEMANTIC SEARCH BASED ON GRAPH ANALYSIS

The Graph structure speaks to hubs indicates highlight terms and edges signify the connection between terms. A Relationship can be co-event, syntactic, semantic or calculated. Once a content archive spoke to as Graph, different diagram examination techniques can be connected on it to process Graph. Graph activity, for example, topological association, Graph crossing point, topological properties, for example, degree coefficient, bunching segment and vertex positioning, little world property discovered viable and productive content archive examination for various applications. The primary favorable position of this examination is that it does not required point-by-point-semantic learning, area or dialect particular gathering. It is exceptionally compact to different domains and languages.

CONFIDENTIALITY OF PUBLIC HEALTH GEOSPATIAL DATA

For public health, a key requirement to the arrival of geospatial information Online has been information secrecy and the assurance from any unapproved revelation, through area, of a person's character. All health offices, including the Central government are exceptionally touchy to any conceivable public arrival of information containing geographic identifiers that could prompt the distinguishing proof of a person, without some defensive and exhaustive prerelease screening Planning and sharing information for Geographic Data Framework mapping makes an extra level of multifaceted nature to these worries. Geographic Data Framework apparatuses effectively can layer, parse and spatially lessen geospatial data from a boundless number of databases and possibly reveal interesting geographic areas on a guide. Regular ways to deal with protect information against divulgence incorporate transient or spatial total, smoothing, and other masking procedures.

PUBLIC HEALTH GEOSPATIAL DATA ON THE INTERNET

The accessibility of public health geospatial information Online is developing. The majority of these databases are accessible as either static or dynamic mapping items. The online tumor frequency maps of New York State Growth Observation Change or hypertension occurrence maps of Esfahan City, Iran Activity give one of the more definite static Web GIS showcases of geographic region and disease result. These maps contrast singular postal districts and expected malignancy rate. Where downloadable, static show information from a source geospatial database could be set up for use in a Geographic Data Framework. Rather than static introductions, geospatial maps end up unique when clients are permitted to get to, or associate with, the database from their own particular PC. Clients can tweak maps and tables and intuitively query the database to scan for highlights construct mostly in light of their own criteria. These consider a more extensive, however foreordained, choice of parameters and instruments for geospatial investigation.

Interoperability

Today, the guarantee of interoperability whereby geospatial information conveyed anyplace Online can be looked, found, recovered and ordered, either by an Internet GIS specialist co-operation person's work area, is getting to be reality. This is a critical achievement given the long-standing absence of industry agreement about equipment stages, working frameworks; organize conventions and programming languages in help of Web GIS utilize.

IV. RESEARCH DESIGN

AN ONTOLOGY-BASED IR MODEL

Our approach expands upon standards from where a general system to use ontologies in the edge of a conventional vector space IR show is produced. In our present work, we address the further difficulties engaged with making the approach plausible on extensive and heterogeneous data storehouses, as required to target commonsense and sensible settings, for example, the Internet. Moreover, we look to devise a methodological approach supporting a formal assessment of the ontology based search approach in the soul and benchmarks of customary IR practice.

The proposed extensions over a ontology based IR model. It gives a short diagram of the first base model, which gives the ground establishment to the research exhibited thus. For particular insights about this model and its assessment.

The center semantic search model depends on an adjustment of the keyword-based IR model. It traverses the four fundamental procedures of an IR framework: ordering, querying, looking and positioning. Nonetheless, rather than conventional Keyword based IR models, in our approach, the query is communicated regarding a ontology based query language and the outside assets utilized for ordering and query handling comprise of a metaphysics and its comparing KB. The indexing procedure is equal to a semantic would notation be able to process. Rather than making a transformed list where the catchphrases are related with the reports where they show up, because of our ontology based IR display, the reversed file contains semantic substances (implications) partner to the records where they show up. The connection or relationship between a semantic entity and an archive is the thing that we call explanation.

SEMANTIC INDEXING

In our perspective of semantic IR, it is accepted that a KB has been constructed and related to the data sources (the record base), by utilizing one or a few domain ontologies that portray ideas showing up in a report content. The ideas and examples in the KB are connected to the documents by methods for express, non-installed annotations of the documents. Since we don't address the issue of learning extraction from content we give a vocabulary and some straightforward components to help in the semi-automatic annotation of documents, once ontology examples have been made. These explanations are later utilized during the recovery and positioning procedures. As we will describe in the following subsection, the ranking algorithm depends on an adjustment of the great IR vector space model In this model, keywords showing up in a document are relegated weights reflecting the way that a few words are preferable at separating between document s over others. Thus, in our framework, explanations are doled out weights that reflecting the discriminative intensity of occasions concerning the documents. Weights are computed consequently by an adjustment of the TF-IDF calculation.(Salton, 1986), based on the frequency of occurrence of the instances in each document. More specifically, the weight *dx* of an instance *x* for a document *d* is computed as:

$$d_x = \frac{freq_{x,d}}{max_y\, freq_{y,d}} . \log \frac{|D|}{n_x}$$

where *freqx,d* is the number of occurrences in *d* of the keywords attached to *x*, *maxy freq y,d* is the frequency of the most repeated instance in *d*, *nx* is the number of documents annotated with *x*, and *D* is the set of all documents in the search space.

QUERYING, SEARCHING AND RANKING

The query execution restores an arrangement of tuples that fulfill the SPARQL query. We at that point remove the semantic elements from those tuples and access the semantic documents to gather every one of the documents in the storehouse that are commented on with these semantic elements. Once the rundown of documents is shaped, the search engine registers semantic comparability esteem between the query and each report, utilizing an adjustment of the great vector space IR model.ach document in the search space is spoken to as a document vector where every component relates to a semantic substance. The estimation of a component is the heaviness of the explanation between the report and the semantic element, if such comment exists, and zero generally. The query vector is produced weighting the factors in the SELECT condition of the SPARQL query. For testing purposes, the heaviness of every factor of the query was set to 1, however in the first model, users are permitted to physically set this weight as per their advantage. Once the vectors are constructed, the similarity measure between a document *d* and the query *q* is computed as:

$$sim(d, q) = \frac{d \times q}{|d| \, . \, |q|}$$

V. ARCHITECTURE AND ALGORITHM

ARCHITECTURE

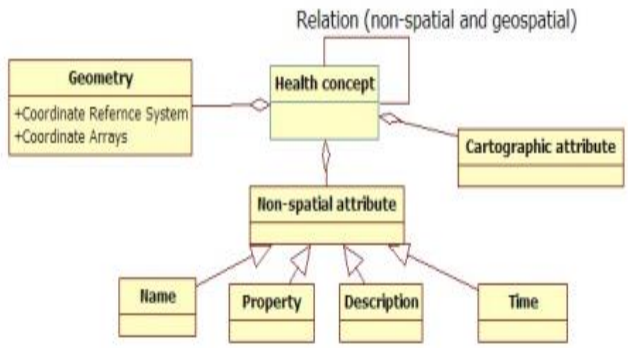

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Figure 1. Health concept meta-model

Health concepts are related to non-spatial and geospatial attributes, as shown in Figure 1. The non-spatial attributes can be name, description, property, and time. Explicit representation of the geospatial attributes is about the geometry and the topology, which allows the discovery of geospatial semantics. Health concepts can be visualized with point, line, or polygon geometries that describe the spatial reference and coordinates of health data. Furthermore, health concepts can include cartographic attributes that specify the styles in map representation. For example, the non-spatial attributes of a health event can be event outbreak time, event type, and event description. The geospatial attributes of a health event can be point geometries showing the latitude and longitude of the event location. The cartographic attributes can describe the styles that are used to show the health event on maps. Relationships, including non-spatial and geospatial relationships, exist between the health concepts and health concept instances.

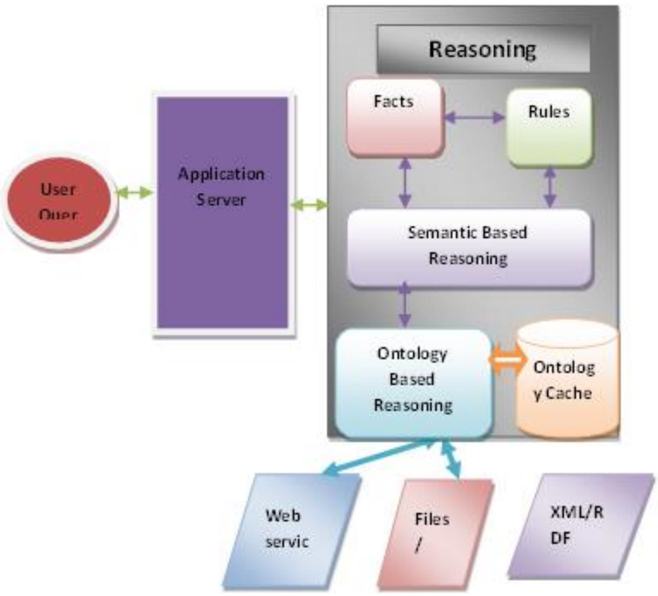

Figure 2. Architecture for semantic health information query.

The architecture for semantic query of health information is shown in Figure 2. Health-related data can be accessed from various sources, such as files, database, Web Services, XML or Geographical Markup Language (GML). Various ontologies could exist in these data sources. These data sources are the essential content for the reasoning server, and will be translated to facts in the knowledge base of the reasoning server. The translation process can use methods like the Extensible Style sheet Language Transformations (XSLT). The knowledge base in the reasoning server includes facts, ontologies, and rules. If different ontologies are used between data sources and the reasoning server, then ontology mapping is needed for translating between data sources.

The ontologies are the formal representation of health concepts and their relationships in the non-spatial and geospatial dimensions. Rules, with the use of ontologies and facts, can deduce new health information. New concepts or knowledge can be described or deduced from rules, without the need to explicate all the knowledge in ontologies and facts. The application server is responsible for performing the business logic of applications (e.g., generating maps from corresponding health data). The query client is used to obtain health data or maps. User ontologies and templates can be designed in the query client for health data query. If user ontologies are different from the ones at the reasoning server, ontology mapping will also be needed during the query process.

VI. ALGORITHM

NON-SPATIAL AND GEOSPATIAL SEMANTIC QUERY

With the spatial information explicitly represented in the RuleML, spatial reasoning can be incorporated in health information retrieval. For instance, the above non-spatial query example can be restricted to find the patient cases within the geospatial boundary "Health region 1". The disease_locator rule is defined to support this query. The gpred_within built-in is used to determine whether the patient location is within "Health region 1".

Disease_locator(health regionname->?name; disease-
>?disease:Respiratory_disease;
startdate >?startdate;
enddate->? enddate;agetype-
>?agetype;age->?age:Integer;gender-
>gender;
postcode->?postcode):-
health_event(disease-
>?disease:Respiratory_diseases:age-
>?age:Integer:gender->?gender:

Postcode->?postcode:admitted->?date).
Age(agetype->agetype:age->?age:Integer).
Earlier(?date,?enddate.)
Later(? Date,?startdate),
Health_region(name->?name; geomentry->?hrgeomentry:Geomentry!?),
Pcode3(name->?postcode; geomentary->?pcgeometry.Geometry,
Gpred_within(?pcgeometry:Geometry, ?hrgeometry:Geometry).

NON-SPATIAL SEMANTIC QUERY

With"Influenza_with_pneumonia"is recorded s health_event (disease>?: Influenza_with_ pneumonia ;age>88:Integer;gender> Female;postcode >E1C;admitdate->date and the spatial location of the three digital postcode E1C is specified aspcode3(name>E1C;geometry>geo [EPSG4326,point [64.8032256544, 46.0988295816]]: Geometry).

The non-spatial semantic query retrieves data sources based on non-spatial attributes, such as name, description, and time. With the ontologies and rules included in the OO jDREW engine, these kinds of queries can be accomplished by the top-down reasoning method. For example, a query is to find the related information of senior people with "Pneumonia_and_influenza" cases recorded by hospitals during the first two months of year 2000. This query requires the use of ontologies we described above, including the respiratory disease ontology and a geontology. From the respiratory disease ontology, the subcategory of "Pneumonia_and_influenza" cases should also be included in the query results. The geontology defines the age range of seniors is above age 65. Therefore, we have defined the disease_query rule, which integrates the ontologies and other rules (e.g., earlier, later) to implement the query.

disease_query(disease-
>?disease:Respiratory_diseases;agetype-

With the disease_query rule, the query results can be retrieved from the Search interface. This interface shows the related information of the patients that meet the query condition, and all the solutions can be iterated by clicking the button 'Next Solution'.

VII. IMPLEMENTATION AND RESULT

IMPLEMENTATIONS

INDEXING

In the proposed view of semantic search, it is assumed that the information available in standard Web pages (the document base) are indexed using the semantic knowledge found in the SW. A key step in achieving this aim lies on linking the semantic space to the unstructured content space by means of the explicit annotation of documents with semantic data. In such a dynamic and changing environment, annotation must be done in a flexible and scalable way. As we explain in the following sections, the solutions explored in this work do not require hardwiring the links between Web pages and semantic markup. On the contrary, these are created dynamically in such a way that the two information sources may remain decoupled. Similarly to traditional IR techniques, which base their ranking algorithms on keyword weighting, our approach relies on measuring the relevance of each individual association between semantic concepts and Web documents. In this case, not just the retrieval process, but also the ranking of query answers can take advantage from the available semantic information. Two different annotation methodologies are studied. The fist one uses Information Extraction methodologies in order to identify in the documents words or groups of words that can potentially represent semantic entities (classes, properties, instances or literals). The second one uses a more scalable approach based on statistical occurrences of semantic entities and their contextual semantic information. Both annotation procedures have been designed considering a set of common requirements:

- ✓ The semantic annotator identifies ontology entities (classes, properties, instances or literals) within the text documents, and generates the corresponding annotations. This is equivalent to a traditional IR indexing process where the indexing units are ontology entities (word senses) instead of plain keywords.
- ✓ The annotation processes carried out do not aim to populate ontologies, but to identify already available semantic knowledge within the documents. In this way, the semantic information and the documents remain decoupled.
- ✓ Differently to other large-scale annotation frameworks, our system has been designed to support annotation in open domain environments. Any document can be associated or linked to any ontology without any predefined restriction. The exploitation of massive amounts of metadata and documents introduces scalability limitations. To address them, we propose the use of ontology indices, document indices, and non-embedded annotations.

QUERY PROCESSING

The most semantic search systems suffer from one of two following limitations when attempting to enhance the conceptual representation of user needs beyond plain keywords: a) usability limitations, where users are expected to use formal query languages to express their requirements and, b) heterogeneity limitations, where a predefined (usually small) set of ontologies is used as the target data set.

SEARCHING AND RANKING

The semantic document retrieval and ranking approach presented here is the same as the one in our initial design .except for the way in which the query vector is constructed. As explained earlier, the document retrieval and ranking algorithm is based on an adaptation of the traditional vector space IR model, where documents and queries are represented as weighted vectors. The query vector components represent the importance of each semantic entity in the information need expressed by the user, while the document vector components represent the relevance of each semantic entity within the document.

ONTOLOGY INDEXING MODULE

To efficiently access large amounts of SW content, Web CORE pre-processes and stores the gathered information in several inverted indices. Two kinds of indices are created, the lexical ontology index, which associates each semantic entity (class, property, instance or literal) with a set of terms or lexical representations, and, the taxonomical ontology index, which associates each semantic entity with its direct subclasses and super classes.

RESULT

SCREENSHOT

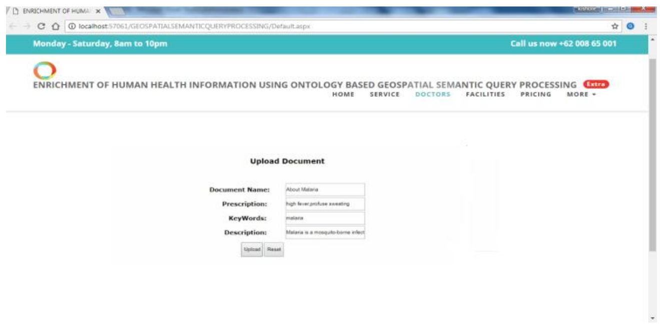

Figure 3. Upload Document

Figure 4. View All Documents

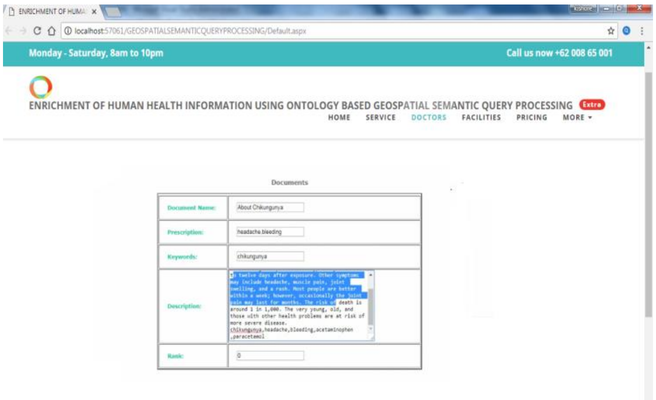

Figure 5. View Disease Data

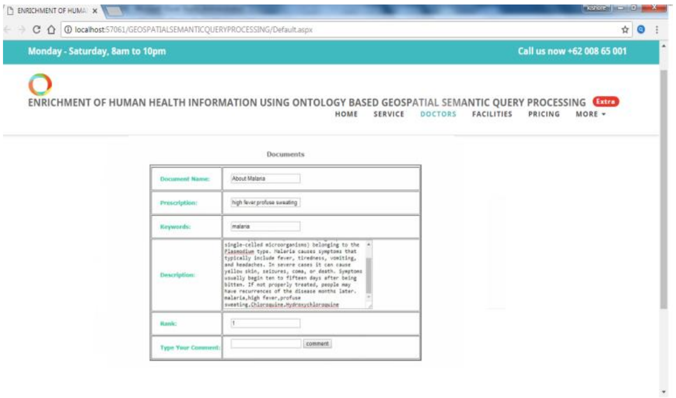

Figure 6. View Document

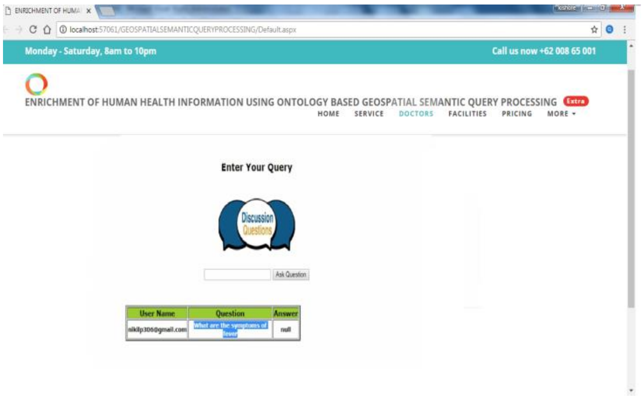

Figure 7. User Search query

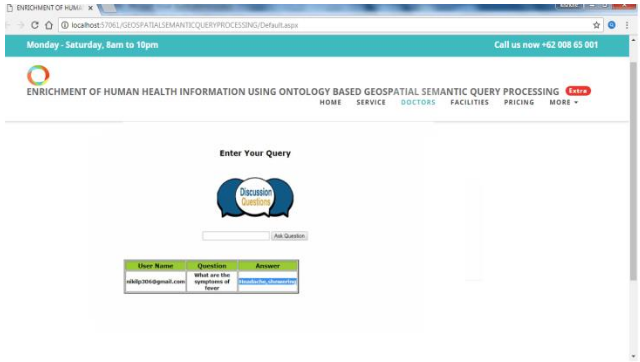

Figure 8. users Search Result

VIII. CONCLUSION AND FUTURE ENHANCEMENT

CONCLUSIONS

In this research the attention is on the non-spatial semantics of health information, utilizing ontologies and tenets. The geospatial part in the health information is consolidated in this examination, and a geospatial-empowered approach has been proposed for semantic health data recovery. The research proposes an engineering that applies ontologies, certainties, and principles in health data thinking and reasoning from both geospatial and non-spatial measurements. Ontologies and tenets have been investigated for the fundamental portrayal of health information from different sources in the Semantic Web. Spatial connection and activity administrators are additionally empowered in the Search engine for spatial thinking and learning revelation. This cosmology and run based health data mix, recovery design gives introductory investigation on the best way to use both non-spatial, and geospatial semantics for health data recovery and the contextual analyses has shown how the semantic query framework functions. Our future work will be on the enhancement of human learning as ontologies and guidelines for health information thinking and derivation to make semantic query frameworks prepared for real health applications.

FUTURE ENHANCEMENT

While the executed principles to make an interpretation of Semantic queries to individual social queries are heuristic based, additionally work is being done with regards to the HeC undertaking to give a formal ground to translate from description logic based ontologies to social queries. The last work will empower us to formally advise the evidence of these foreseen interpretations from a perspective of accuracy, consistency, and fulfillment. Likewise, there are issues that stay to be taken care of when utilizing this heuristic approach. This is particularly evident while setting up the request and mixes of ontological expressions previously they can be translated to relational queries. In spite of these restrictions, the ebb and flow research work has given us a more profound understanding into the issue by detailing an arrangement of heuristics as a stage to controlling the foreseen robotization of this ontology social interpretation process. Finally, we envision that this approach will prepare for an intelligent procedure where aftereffects of queries' execution will improve the present archive of area ontologies

IX. REFERENCES

[1]. Leidner A, Homeland Security Working Group, Federal Geographic Data Committee,unpublished data, January 31, 2002

[2]. Foresman TA. Spatial analysis and mapping on the Internet. J of Public HealthManagePrac. 1999;5(4):57-64.

[3]. Karr A, Lee J, Sanil P. Web-based Systems that Disseminate Information from Data but Protect Confidentiality. In Elmagarmid AK, McIver WM.(ed). Advances in Digital Government. KluwerPress. Amsterdam. 2002. p 181

[4]. Niemann B. XML Web Services: Virtual Centralization of Distributed Content. Unpublished data.2002.

[5]. Clarke KJC, McLafferty SL, Tempalski BJ. On Epidemiology and Geographic Information Systems: A Review and Discussion of Future Directions. Emerging Infectious Dis. 1996;2;(2):85-92

[6]. Melnick AL. Introduction to Geographic Information Systems in Public Health.Gaithersburg: Aspen Publishers, Inc. 2002.

[7]. Federal Geographic Data Committee. Geospatial Information One-Stop To Spatially Enable Delivery of Government Services. 2002. Available at http://www.fgdc.gov

[8]. Broome FR, Meixler DB. The TIGER Data BaseStructure. Cartography andGeographic Information Systems. 1990;17(1):39-47

[9]. Cromley EK, McLafferty SL. GIS and PublicHealth. New York: The Guilford Press. 2002. p1043

[10]. National Cancer Institute. Geographical Information System for Health (GIS-H).2002. Available at http://www.healthgis-li.com

[11]. US Environmental Protection Agency. Enviromapper. 2002. Available at http://epa.gov/superfund/sites/ index.htm

[12]. Grubesic TH, Murray AT. Constructing the divide :Spatial disparities in broadbandaccess. Papers inReg. Sci. 2002;81(2):197-221

[13]. Rushton G, Lolonis P. Exploratory spatial analysis of birth defect rates in an urbanpopulation. Statistics in Medicine 1996;15:717-26

[14]. Cox, LH. Bounds on Entries in 3-Dimensional Contingency Tables Subject to Given Marginal Totals. In Inference Control in Statistical Databases. Lecture Notes in Computer Science 2316,ed. J Domingo-Ferrer. Berlin: Springer-Verlag 2002. pp. 21-33.

[15]. Croner CM. Geographic Information Systems(GIS): New Perspectives in Understanding Human Health and

Environmental Relationships.Stat.inMed. 1996;15:1961-1977

[16]. Grossman RL. Data Space Fact Sheet. 2001. Available athttp://www.dataspaceweb.net

[17]. Steel P, Sperling J. The Impact of Multiple Geographies and Geographic Detail on Disclosure Risk: Interactions between Census Tract and ZIP Code Tabulation Geography", Proceedings of Survey Research Methods Section, American Statistical Association. 2001.

[18]. Richards TB, Croner CM, Rushton G, Brown CK,Fowler L. Geographic Information Systems and Public Health: Mapping the Future.PubHealthRep. 1999;114(4):359-373

[19]. Maryland. Department of Planning. Hot Spot Communities & Spot Light Schools. 2002. Available at http:// www. mdp.state.md.us

[20]. Thrall GI. The Future of GIS in Public Health Management and Practice. J of Pub Health Manage Prac. 1999;5(4):75-82