Covenant Journal of Informatics & Communication Technology. Vol. 9 No. 1, June, 2021
ISSN: ***print*** **2354 – 3566** ***electronics*** **2354 – 3507 DOI:**

An Open Access Journal Available Online

Restaurant Multi-Context-Based Information Retrieval System Ontological Model

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Received: 29.02.2021 Accepted. 24.05.2021

Date of Publication: June 2021

Abstract— This paper aims to improve information retrieval results by considering multi-context-based information that can be associated with retrieval. Traditional Information Retrieval has been termed inefficient because of its lack of consideration for individual user preference and contexts. An example domain where user preference and context consideration are expedient is the restaurant and food information retrieval domain. Current food-based ontologies do not provide sufficient information to tackle this challenge. We analysed existing food-based ontologies, developed and evaluated a restaurant-food-based ontology that provides application developers with a formalised restaurant-food ontology that will foster interoperability and information sharing within the domain. The ontology was developed using the methontology methodology for ontology development. Our restaurant-food ontology is based on ontology web language (OWL) and implemented in Protégé ontology editor. Using standard ontology evaluation measures of competency (in terms of precision and recall) and consistency, our results show that our ontology is 100% competent and can be used to build a range of applications that require answering a wide range of queries correctly that are general, detailed, context-based (location and environmental) and preference-based. This is currently, beyond what traditional Information retrieval and location-based systems can answer with accuracy.

Keywords/Index Terms—Contextual Information Retrieval, Information Retrieval,

Ontology, Semantic Web

1. Introduction

The 70s was said to be the beginning of the internet when the first internet network was designed to create a communication medium (Licklider, Robert, & Taylor, 1968). In that generation, only experts were connected to the internet. It was document-focused and not commercialised (Sack, 2015; Ugochukwu, 2018). To access the internet, a user would have to use a Command Line Interface (CLI) to connect to a remote system, find the file of interest, then download the file from the remote system to their local system. This was a complex process that required expert knowledge which made information retrieval expensive and limited to only experts (Sack, 2015). Since then, the internet has grown through three newer generations (Ugochukwu, 2018). The next generation moved from document focus to data focus (Sack, 2015; Smith, 2018) and from research and development to commercialisation (Ugochukwu, 2018). It was called the Semantic Web. Web browsers such as Mosaic, Netscape etc. provided a Graphical User Interface (GUI) as opposed to the former Command Line Interface (CLI) from the previous generation for internet access. The Hypertext Mark-up Language (HTML) was invented to describes how the information was presented and linked with each other. With this invention, accessing information no longer required expert knowledge, and Information Retrieval became usable because of the presence of search engines, crawlers etc. The semantic web provided a common concept that allowed for data to be shared and reused across various applications and in combination with other web-based technologies (Eftimov, Ispirova, Potočnik, Ogrinc, & Koroušić Seljak, 2019).

The growth of the internet presented a challenge for personalised information retrieval relevancy. This challenge arose from the fact that traditional information retrieval returns the same information to users even if they were in different context and had different preferences. The problem is compounded by the fact that (1) machines do not have contextual knowledge and experience that allows them to derive meaning from implicit knowledge which enables them to decide what is relevant and to rate how relevant, and (2) HTML was designed to describe how the information is presented and linked and not for meaning. What simplifies the solution is that multiple contextual data from various homogeneous and heterogeneous sources are available. However, they are not linked and no meaning derived. How do we then achieve information relevance? Researchers such as Bouramoul, Kholladi, & Doan (2010), Coutinho, Asnani, & Caeiro (2012), Fisher & Hanrahan (2010) and Lamsfus, Martin, Alzua-Sorzabal, López-de-Ipiña, & Torres-Manzanera (2012) response to this was the inclusion of more context to Information Retrieval.

In this paper, we develop an ontology for a multi-context-based information retrieval system using the restaurant domain as a use case. This paper is structured as follows, section 1 talks about the Introduction, literatures reviewed were discussed in section 2, section 3 talks about the analysis of current food-based ontologies, section 4 discusses the methodology, section 5 shows the results and conclusion was done in section 6.

2. Literature review

The semantic web is defined as "a set of standards and best practices for sharing of data and the semantics of such data over the web for use by applications" (Blower, Riechert, Koubarakis, & Pace, 2016; DuCharme, 2011). Two phrases are highlighted here: a set of standards and best practices for sharing data. The set of standards are the universal formats such as the Resource Description Framework (RDF) data model, the SPARQL (SPARQL Protocol and RDF Query Language), the RDF schema and Ontology Web Language (OWL) standards for storing vocabularies and ontologies. The best practices for sharing data over the web are the use of Uniform Resource Identifier (URI) for naming and to use the standards such as RDF for modelling and SPARQL for querying. Through this practice, we have guidelines for the creation of an infrastructure for the semantic web. The semantic web integration present knowledge about data, allow data integration and bring intelligence to systems (Smith, 2018). These newer generations of the internet led to an exponential increase of the web and the web moved from storing documents to connecting all kinds of data generating devices to the extent that as of today, for every second there are about 24 terabytes of data uploaded to the internet. Emphasising the phrase "data never sleeps".

At the core of semantic web-based applications are ontologies (Eftimov et al., 2019). Ontologies are considered as the fundamental data object for organizing and connecting knowledge through the web (Snae & Brückner, 2008). Ontology in general comes from two Greek words: "Onto" and "Logia". Onto meaning existence or being real and Logia meaning science or study. Ontology is said to have emerged at first in computing at about the same time as the creation of the internet where Stanford researchers used ontology as a formalization of common-sense knowledge (Smith, 2018). They wanted to build a robot with Artificial Intelligence and wanted the robot to know what people knew and the researcher at that time wanted to formalize what people knew. So, they called that formalization an ontology. The most referenced definition of ontology is the one provided by (Gruber, 1995). They describe ontology as "a formal, explicit specification of a shared conceptualisation". This description provides us with four key terms: conceptualization, explicit, formal and shared. Formal means that entities are represented in computer-readable form, explicit specification means that the concepts and constraints on them are clearly defined, shared means consensual knowledge (agreeable by a group of persons) and conceptualization entails the use of abstract models to depict what is understood about entities in a domain of interest (Daramola, Adigun, & Ayo, 2009). In any given specific domain, different ontologies can be created due to a range of factors such as different intended use, language, perception etc. (Eftimov et al., 2019).

The use of ontology allows the sharing of domain knowledge using a common vocabulary across heterogeneous platforms. It enables the sharing of information structure among people and software agents, and it also helps to standardize models, processes and knowledge architecture (Daramola et al., 2009; Dooley et al., 2018). An ontologist extracts human knowledge and model it in a way that is understandable by the computer so that the component can be automated to do what humans can. The use of ontologies in Information Systems has become popular and has become more commonly used in fields such as web technologies, database integration, artificial intelligence, information extraction, risk management etc. (Abayomi-Alli et al., 2021; Abioye, Arogundade, Misra, Akinwale, & Adeniran, 2020; Arogundade, Abayomi-Alli, & Misra, 2020; Boulos, Yassine, Shirmohammadi, Snae, & Brückner, 2015; Roussey, Pinet, Kang, & Corcho, 2011).

The main components of an ontology are concepts (classes), individuals and relationships (properties). The relationship (properties) connects concepts to a set of individuals who are assigned to each of the concepts (Eftimov et al., 2019). Classes describe the concept of the domain and there can be superclasses and subclasses. Individuals are the instances of the classes while properties are the relationship between individuals. There are three types of properties; object property (the relationship between two individuals e.g., hasSibling, livesIn), datatype property (the relationship between individuals and data values e.g., hasAge) and annotation (used to add metadata to classes, individual and object/datatype properties).

In recent years, many ontological languages have been proposed and developed such as Knowledge Interchange Format (KIF), LOOM, FLogic, Operational Conceptual Modelling Language (OCML), Simple HTML Ontology Extension (SHOE), Resource Description Framework (RDF), XML-based Ontology-exchange Language (XOL), DARPA Agent Mark-up Language (DAML) and Ontology Web Language (OWL) (Hussain, 2011). However, OWL is regarded as one of the most used ontology language (Zhai, Martínez Ortega, Lucas Martínez, & Castillejo, 2018). OWL is considered as the ontology language of the semantic web because it provides a rich vocabulary to add semantics, context, reasoning and inference to data. It is a standard for formally specifying knowledge on the semantic web (Tumnark, Oliveira, & Santibutr, 2013). The two main applications of OWL are; quick and scalable data modelling and effective automatic reasoning (Hjelm, 2001). Although OWL is a modelling language in the traditional sense it has more advantages than modelling languages of the past such as UML, XSD etc. It is expressive, flexible and efficient.

One of the most used ontology development software is Protégé. Protégé is a free and open-source ontology editor (Protege, 2020). It is a knowledge management system because it provides the interface to define new knowledge, it provides deductive classifiers to validate the consistency of models and also infers new information based on analysis of an ontology. Protégé can be called an Integrated Development Environment (IDE) like Ellipse because it offers plugins for extensibility. It delivers several ways to visualize concepts and relationship, such as in hierarchical trees etc. (Soza & Garrido, 2020). It also provides reasoning support to systems and improves the structure and effectiveness of search, knowledge reuse and sharing which can be used to build search engines (Globa, Novogrudska, Koval, & Senchenko, 2018; Malik & Jain, 2017; Soza & Garrido, 2020). Protégé has several reasoners with HermiT as its default (Motik, Glimm, Stoilos, Horrocks, & Shearer, 2011). A reasoner can infer logical consequences from a set of asserted facts or axioms. It infers the hierarchy of classes that are not explicitly described in the ontology (Ayorinde, Akinkunmi, & Ogundipe, 2019). Other protégé reasoners are Racer ELK 0.4.3, FaCT ++ 1.6.4, Mastro DL-Lite, Ontop, Pellet, Pellet (incremental) etc.

Protégé allows for the visualisation of ontology through several plugins such as OWLViz (Horridge, 2019), OntoGraph (Falconer, 2013), (OWLGrEd, 2012), VOWL (Visual Notation for OWL Ontologies) (Steffen & Negru, 2016). The default protégé installation comes with OntoGraph. OntoGraph allows for the visualisation of concepts and neighbouring concepts, view classes and neighbouring classes based on their relationship in ellipse and arrows. Visualising an ontology provides an alternative way of navigating and exploring our models in diagrammatic form.

Protégé allows for the querying of ontologies through several plugins such as DL query (Protege, 2016), Existential query, SPARQL query (Redmond, 2014) etc. DL query is the default. Through the DL query tab, a user can write queries in the form of class expressions. The query language (class expression) is based on the Manchester OWL syntax (Horridge & Patel-Schneider, 2012) which is a user-friendly syntax for OWL DL that is based on collecting all information about a particular class, property or individual into a single construct called a frame. For example, to find a facility that has a bar, one will express this as 'hadFacility value Bar' where hasFacility is an object property and Bar is an instance. It uses keywords for expression such as some, value, only, min, max, exactly and, or and not. Protégé also provides an inbuilt debugger called OntoDebug (Schekotihin et al., 2019).

Here, the restaurant domain is considered as an example domain because it represents a complex contextual domain and an active domain for context-based IR challenges. When considering multi-context IR, the restaurant domain is employed frequently to depict other domains because of the vast amount of context it involves. Also, it has close ties with other large domains like health, nutrition and tourism (Agarwal, Mittal, Bansal, & Garg, 2015; Helmy, Al-Nazer, Al-Bukhitan, & Iqbal, 2015). When people search for a restaurant, it gives them generic information without taking into consideration their various preferences (allergies, budget etc.) and the context they are in such as the state of the road, the weather, location and time. Based on this, we design a restaurant-based ontology for a multiple contextual Information Retrieval system.

3. Analysis of current food-based ontologies

Ontologies have been used by a wide range of researchers as regards to the food domain (Bailoni, Dragoni, Eccher, Guerini, & Maimone, 2016; Hussain, 2011; Madalli, Chatterjee, & Dutta, 2017) and related domains such as tourism (Chantrapornchai & Choksuchat, 2016; Daramola et al., 2009; Pai, Wang, Hsu, Lin, & Chen, 2019). In table 1, we analyse a range of food-based ontologies.

Table 1 An analysis of the current food-based ontologies

Ontology Name and Author	**Area**	**Aim**	**Technology used**	**Limitation**
Open food facts; (Open Food Facts, 2020)	Food and nutrition	To help users make better choices about their food consumption	OWL, RDF	It may contain errors as it is updated by individuals around the web
ISO Food; (Eftimov et al., 2019)	Food and nutrition	To support research in the domain of food isotopes.	OWL, RDF	Could not access
ONS (Ontology for Nutritional Studies); (Vitali et al., 2018)	Nutrition	To assist nutrition researchers	OWL, RDF,	
FoodOn; (Dooley et al., 2018)	Human and domestically animal food	To build a comprehensive and easy to access global ontology about food	OWL	
PerkApp Ontology; (Bailoni et al., 2016)	Food and Health	To provide a platform to support users health	OWL	
Food Wiki; (Celik, 2015)	Food	To build safe food consumption system	OWL, RDF	Limited to packed food Not opened source Limited to food products in the Turkey ministry database
Food product ontology; (Boulos et al., 2015)	Food	To describe food products with a common vocabulary	OWL, RDF	Limited to food products in the Russia ministry database
Dietary Ontology for weightlifting; (Tumnark et al., 2013)	Food and Health	To provide specific menus for athlete's dietary needs and preferences	OWL	Could not access

AGROVOC; (Caracciolo et al., 2012)	Agriculture	To build a large thesaurus covering all areas of FAO interest.	OWL, RDF,	Accessible only by experts and organization Not open source
FOODS (A Food-Oriented Ontology-Driven System); (Snae & Brückner, 2008)	Food and Health	To deliver a food menu recommender system for diabetes patients	RDF	Ontology in the Portuguese language Limited. No information based on ingredient Limited to food products in Thailand
Health and exercise ontology; (Izumi et al., 2006)	Food and Health	To provide a health advice system	OWL, RDF	Details not specified

The analysis of existing food-related ontologies shows the technology used by the different ontologies. Such as OWL, RDF etc. It can be seen that most have either the limitation of being for a specific purpose or language or location and none is truly universal. Although they all seem different, they can overlap as long as they use similar technology or product type (Boulos et al., 2015). For example, Open Food Facts and Food Wiki both use OWL and are focused on packed food products. Also, some ontologies are a combination of multiple ontologies. An example is ONS which is a combination of the FoodOn and 22 other ontologies (Vitali et al., 2018).

There is a need to expand current food-related ontologies to be more inclusive of other fields that will enable a better understanding of human dietary behaviours from not just the perspective of food and nutrients taking but also other social and environmental determinants (Eftimov et al., 2019; Helmy et al., 2015). This is in line with the aim of this research to consider multiple contextual information to improve retrieval. Overcoming the limited scope of these ontologies will require an ontology that covers economic constraints, taking into account the price and cost (maybe based on the user budget), Available ingredients and Nutritional effects (Snae & Brückner, 2008). Other considerations could be the distance of getting them, health status (allergies, illnesses), nutritional composition etc.

In the next section, we show our method for the development of a restaurant-food-based ontology that is extended to cater for multiple contextual Information Retrieval. With the inclusion of context-based information and user food preference about health, religion etc.

4. Method

There is no defined method for building an ontology (Noy & Mcguinness, 2001). Ontology development is an iterative process that repeats continuously and improves the ontology (Corcho, Fernández-López, Gómez-Pérez, & López-Cima, 2005; Eftimov et al., 2019; Sack, 2015). Common examples of ontology development methodologies are methontology (Fernandez, Gomez-Pearez, & Juristo, 1997) and Ontology development 101 (Noy & Mcguinness, 2001).

We used the methontology methodology for ontology development. Methontology is commonly used to build ontologies from scratch and it has been proposed for ontology construction by the Foundation for Intelligent Physical Agents (FIPA), which promotes interoperability across agent-based applications (Corcho et al., 2005). It is developed to be in line with the system development life cycle which makes it ideal for information science research of this kind. Its stages are planning, specification, knowledge acquisition, conceptualisation, integration, implementation, evaluation, documentation and maintenance.

4.1.Planning

Our focus for the building of an ontology was to provide the connection between restaurants and multiple context-based information related to them such as environmental context, location context, user preferences etc. The development of our ontology has been driven by this question: What available data can make users search for restaurant to return more relevant results? The rationale for the development of the ontology is to engage in the use of preference and multiple context-based information from nature and man-made sensors or sources.

Our competence questions are the questions we expect the ontology to answer when queried after the ontology is completed. They are divided into general, detailed, location-based, preference-based, context-based and complex questions. These are example question types a multiple context-based Information Retrieval ought to answer. General questions are simple text-based retrieval type questions. Detailed questions are questions that contain a specific description of a general entity. Location-based questions are questions that require a location context. Preference-based questions are questions that are based on individual preferences. Environment context-based questions are questions that require the system knowledge of the environment surrounding the entity such as state of the road, weather, time of the day etc. and complex questions are questions that require a combination of two or more of the other types of questions; general, detailed, location-based, preference-based and environmental-based. We expect a multi-context-based ontology to answer all forms of these questions from general to complex questions.

Table 2 List of competency questions the ontology is expected to answer

General question(s): List of restaurants
Detailed question(s): List of Chinese restaurants
Location-based question(s): Restaurants near me
Preference-based question(s): Which food is good for diabetes? Which food is good for vegetarians? Which drink is good for Muslims? Which food is not expensive?
Context-based question(s): Which restaurant has a motorable road?

Complex question(s): which restaurant is near me and does home delivery (a detailed location-based question), which restaurant is near me, has a motorable road and has food suitable for vegetarians (a location, environmental and preference-based question)

4.2.Specification

The purpose of the ontology is to show multiple context-based information that can be associated with user restaurant search behaviour that its inclusion will improve information retrieval. The ontology is expected to be used to a build user-centric restaurant-based information type application and used by web developers. The scope will be a range of restaurants in Nigeria in a part of Lagos state. Our sources of knowledge are Jumia food (a restaurant-based website), Google Map (web resources related to environmental mapping) available at maps.google.com and health resource such as (American College of Allergy, Asthma and Immunology, 2014). This information formed our requirement specification.

4.3.Knowledge acquisition

Information was acquired from Jumia Food (2020), Google Map and American College of Allergy, Asthma and Immunology (2014). Information of 21 restaurants were manually scrapped from Jumia food's web application after a filtered search of City: Lagos City and Area: Lekki-Chevron was applied. Jumia food is a food delivery web application that houses the information of a wide range of restaurants across most states in Nigeria (Jumia Food, 2020).

Table 3 Sample of the data scraped from the food delivery application

Restaurant name	Address	Coordinates	Rating	Price	Description
Laredochops	44 Omididun St, Lagos Island	6.456072, 3.394615	4.8	₦	Finger Foods, Small Chops
Sushi Holic	28 Admiralty Way, Lekki Phase 1	6.44815, 3.472659	4.5	₦ ₦ ₦	Asian, Beer, Beverages, Seafood, Vegetarian, Japanese
PAKPointy	Jacob Mews Estate, Yaba	6.4976, 3.380909	3.8	₦	African, Nigeria, Igbo, Traditional Cuisine

Where ₦, ₦ ₦, ₦ ₦ ₦ means low price, medium price and high price receptively.

From the American College of Allergy, Asthma and Immunology (2014) a list of food allergies was identified. 8 types of food account for 90% of all food allergy reaction; egg, milk, peanut, tree nut, fish, shellfish, wheat and soy. This concept is useful as a user can exclude food that contains ingredients they are allergic to.

Google Map provide the functionality to check for traffic around an environment, infer road conditions and determine distance from one address to another. This is denoted with the colour lemon green, orange, red and magenta Where green is no traffic and magenta mean heavy traffic. We assume that any restaurant more than 20 minutes away from the user is considered far and less than 20 minutes is considered as near, using Lekki Waterside Hotel as our central point. Further considerations can also be made based on the user mode of transportation if they are driving, walking or taking public transportation as this can influence distance. For example, a less than 20 minutes drive can be considered as near distance but that same distance can be about 2 hours 30 minutes without shortcuts walking.

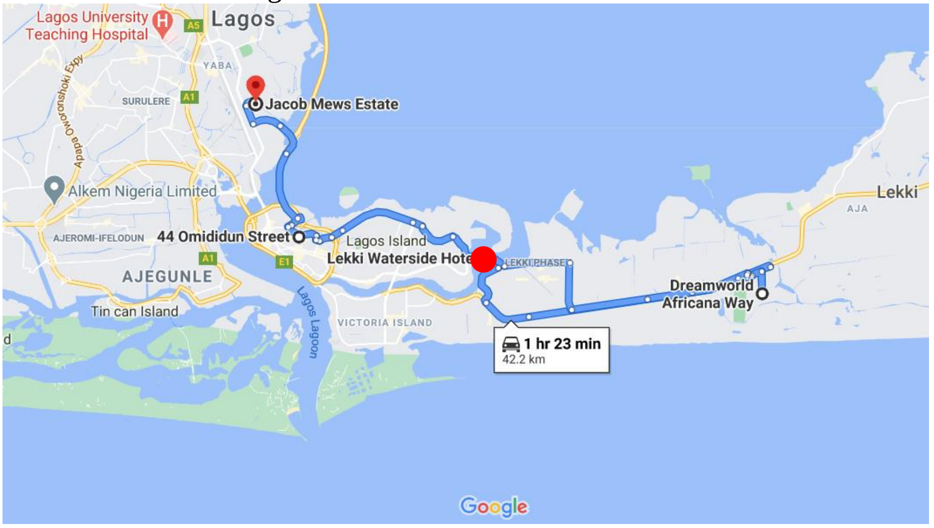

Figure 1. Google generated map from the user central point to serval restaurant locations

4.4.Conceptualisation

To design our conceptual model a taxonomy was developed using a mix of top and bottom approach using data gathered from the knowledge acquisition stage.

Below is a top-level conceptual model.

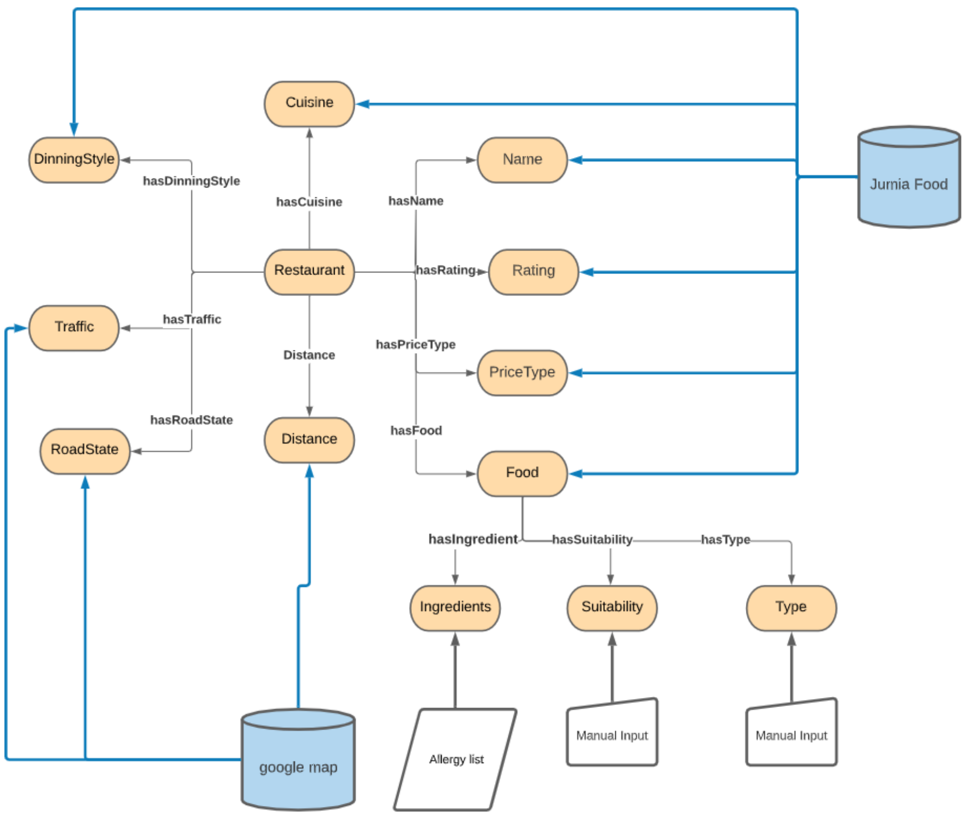

Figure 2. UML diagram showing the conceptual model for the ontology

Figure 2 shows the conceptual model or conceptual taxonomy illustrating classes, properties and data sources. We have 1 top class, Restaurant. The Restaurant class contains information that describes a restaurant such as a name and entities that affect people choice of restaurant in terms of context and preferences such as rating, pricing, distance, traffic, food, state of road and dining style. The relationship between these features or classes were modelled using corresponding OWL object properties of hasDinningStyle, hasTraffic, hasFoodPrice, hasFood, hasIngredient, hasSuitability, hasDistance, hasPrice, hasCuisine, hasFoodDiet, hasFoodClass and hasRating and OWL data properties of hasName and hasAddress. The ontology was populated with OWL individuals. Some of the classes have subclasses while some have instances listed.

4.5.Implementation

The ontology is based on ontology web language (OWL) and implemented in the Protégé 5.5.0 ontology editor. We used the OntoGraf tool to visualise the ontology. OntoGraf is an interactive tool that enables the visualisation of ontologies in ellipse and arrows to visualise relationships in a graphical manner.

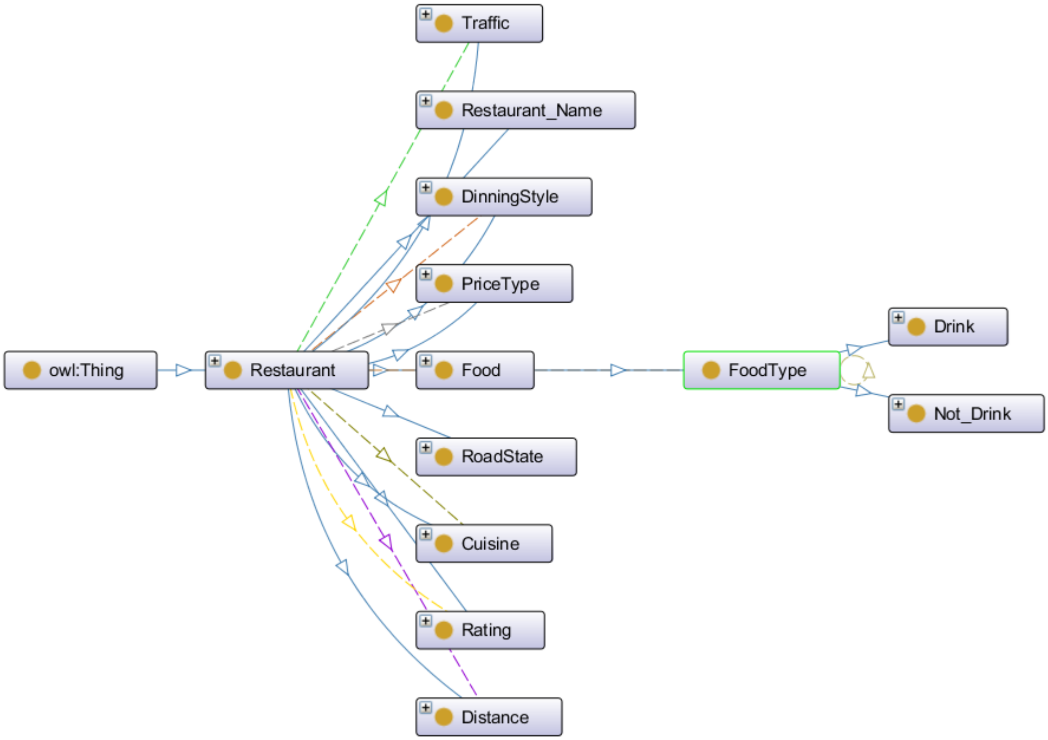

Figure 3. Top-level classes and their relationships generated using OntoGraf

4.6.Evaluation

The ontology was evaluated based on two standard ontology evaluation metrics; Verification and validation (Sack, 2015). Verification is a test of correctness in terms of consistency and coherency. This was tested with a combination of default protégé reasoner HermiT and debugger OntoDebug. Validation is a test of purpose in terms of competency. This was tested using the set of competency questions set at the planning stage.

Validation is a test of competency in terms of standard information retrieval measures such as precision and recall. Precision is measured as the proportion of the total number of relevant items identified among the total number of retrieved items (Okoro, 2014). Recall is measured as the proportion of the total number of relevant items identified among the total number of relevant items in the item population (Okoro, 2014). Querying an ontology is a form of evaluating an ontology as the researcher can get a dive into the type of results the ontology produces based on the sample questions created during the planning stage of the ontology development life cycle (Ayorinde et al., 2019). By comparing the ontology with the specification requirement. It is in the form of, we said the ontology should be able to answer several questions written during the planning stages so let us see if it does answer them. We used the DL query tool to query the ontology for competency and measure the precision and recall of the retrieval. Competency questions are questions that the ontology must answer with its axioms. These questions serve as requirement specifications for ontology development. The ontology was evaluated using these questions, they were written in the ontology development editor in the DL-query tab. The questions were classified as general, detailed, location-based, preference-based, environmental-based and complex questions.

5. Result

The result of the test for consistency and coherency shows the ontology is consistent and coherent.

The result of the test of competency based on the competency questions set during the planning stage of the ontology development and the class expressions used to query the ontology is presented in the table below.

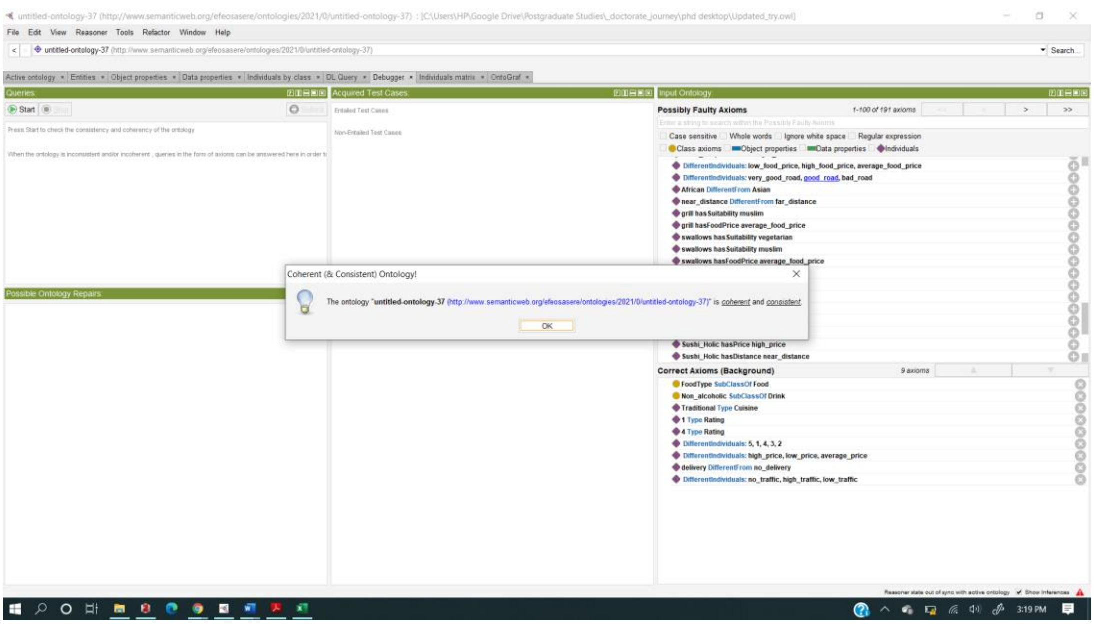

Figure 1. Result of the test for consistency and coherency

Table 1 showing the competency questions, their class expression and the precision and recall result

Question type	Literal meaning	Class expression	Precision	Recall
General	List of restaurants	Restaurant_Name	21/21	21/21
Detailed	List of Chinese restaurant	hasCuisine value Asian	1/1	1/1
Location-based	Restaurants near me	hasDistance value near_distance	10/10	10/10

Preference-based	Which food is good for diabetes	Not_Drink and hasSuitability value diabetes	6/6	6/6
Preference-based	Which food is good for vegetarians	hasSuitability value vegetarian	11/11	11/11
Preference-based	Which drink is good for Muslims	Drink and hasSuitability value muslim	1/1	1/1
Preference-based	Which food is not expensive	Not_Drink and hasFoodPrice value low_food_price	6/6	6/6
Context-based	Which restaurant has a motorable road?	hasTraffic value no_traffic or hasTraffic value low_traffic	16/16	16/16
complex-based	Which restaurant is near me that do home delivery	hasDistance value near_distance and hasDinningStyle value delivery	10/10	10/10
complex-based	Which restaurant is near me that has a motorable road and has food suitable for vegetarians	hasDistance value near_distance and hasDinningStyle value delivery and hasRestaurantSuitabili ty value vegetarian	1/1	1/1

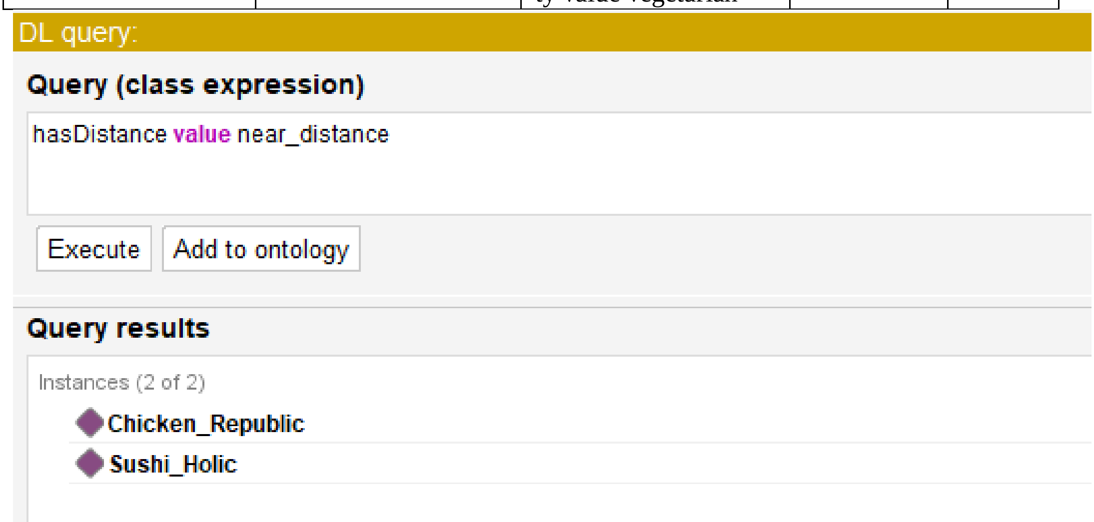

Figure 2 Screenshot of a test for competency

6. Discussion and conclusion

This paper aims to improve retrieval results by considering multi-context-based information that can be associated with retrieval. We analysed existing food-based ontologies and developed and evaluated a restaurant-food-based ontology that provides application developers with a formalised restaurant-food ontology that will foster interoperability and information sharing within the domain.

The results of our evaluation showed that the developed ontology was consistent, coherent and competent by answering a wide range of queries correctly that are general, detailed, context-based (location and environmental) and preference-based. This is beyond what traditional Information retrieval and location-based systems can answer with accuracy. The next phase of this project is to (1) Incorporate logic reasoning to enable retrieval prioritisation based on user factors. This will allow retrieval systems to rank the results to be returned and in what order to return them. (2) Connect the ontology to a database towards the development of an application for further exploration and user testing. (3) Expand the current ontology. Since the current ontology considers user preference in terms of health conditions such as diabetes, a combination of the FOODS (diabetes edition) ontology with other health considerations like ulcer, high blood pressure etc., with the inclusion of other environmental context-based sources will be considered.

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