

SEMANTIC DRIVEN MICRONUTRIENT RECONNAISSANCE SYSTEM

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ABSTRACT

Micronutrients play major roles in human development and safeguarding the wellbeing of every individual. The basis of high incidence of morbidity and mortality, in the human race, mostly characterized by Micronutrient deficiency has been traced to great level of ignorance among others. Information requires a medium and a major source of it in this advent of advancement in technology is the web. Currently, the web is majorly syntactic and the keyword based search result is characterized by ambiguous contents, only readable by humans. Such challenge is eminent in micronutrients related information searches, posed with several human readable web pages, of which a lot time is spent jogging on the diffused web contents for most relevant information.

Based on this, vitamin and mineral consumption has been restricted to just a few, while the body system weeps over the deficiencies, resulting in one ailment to the other. This work takes into consideration the advantage of the ongoing web evolution of adding semantics to Web resources and the available tools. As such is implemented with the use of ontology, a knowledge representation formalism, which allows machine readable descriptions to be added to the vitamin and mineral domain concepts or data. This enables a semantic search with precise and accurate results through the developed web application.

Keywords: Micronutrient deficiency, Vitamin and mineral domain, Semantic search, Ontology

1. INTRODUCTION

The importance of Micronutrients cannot be over emphasized. They play vital roles in human nourishment, which includes the prevention and cure of several ailments and states of health, as well as the optimization of physical and mental functioning, regulation of metabolic rate, heartbeat, cellular pH and bone thickness. Micronutrients are so called because they are required only in minute quantities. However, as small as micronutrient dosage quantities are, the penalties of their lack are terrible. Absence of micronutrients [14] can result in inhibited growth in children and increased risk for various diseases in adulthood. Among several interventions by health organizations around the world, to deliver micronutrients to the populace, the importance of individual awareness and ascertaining/identifying the right intake at correct proportions (RDA), nutrient preservation, food sources, tolerance level, interaction, and types of vitamin and mineral cannot be overemphasized. The most tenable means of accessing such information in this age of technological advancement is the web, through web browsers. With the keyword based search imposed by the current web 2.0 search engines, search result is characterized with cumbersome and ambiguous contents, only readable by humans. Such challenge is eminent in vitamin and mineral domain related information searches, posed with several human readable web pages, of which a lot time is spent joggling on the diffused web contents for most relevant information. This whole process violates time economic rule of information retrieval and access. This work is however a plunge into the ongoing webs evolution of adding semantics to web resources (semantic web) and the available tools. A major building block of semantic web is the ontology. With ontology, computers can sometimes act as if they “understand” the information they are carrying and this is where the “semantic” comes in [3]. As a major feature of this work, Micronutrient Deficiency Monitoring Ontology, MIDEMO, was created as the semantic backbone of the developed web application to be developed.

2. RELATED WORK

Micronutrients are nutritional constituents, usually described as Vitamins and minerals, which are needed in tiny quantities by the body, are crucial to growth, ailment preclusion and health. Micronutrients are not produced in the body and must be derived from the diet (Sight & Life, 2011). Deficiencies in micronutrients such as iron, iodine, Vitamin A, folate and zinc can have devastating penalties (Investigating the Future, 2009). Government guiding principle on vitamin deficiencies suggests definite consumptions for wellbeing, by means of precise values for women, men, babies, aged and during

perinatal period or breastfeeding (Dietary Reference Intake). Monitoring is the carrying out surveillance on an environment or people in order to detect signals, movement or change of state of quality (Wiktionary). The term “Ontology” can be defined as an explicit specification of movement or change of state of quality (Wiktionary). The term “*Ontology*” can be defined as an explicit specification of conceptualization. Explicit specification of conceptualization means that the ontology is a description (like formal specification of a program) of the concept and relationships that can exist for an agent or a community of agents (Dhana, 2014). The semantic web is an evolution and extensions of the existing web that allows computers to manipulate data and information (Dhana, 2014). *Semantic search* denotes search with meaning, as distinguished from lexical search where search engine look for literal matches of the query (Bast, 2016)]. It seeks to improve search accuracy by understanding the searcher’s intent and the contextual meaning of terms as they appear on the searchable dataspace, whether on the Web or within a closed system, to generate more relevant results (John, 2012). Some authors regard semantic search as a set of techniques for retrieving knowledge from richly structured data sources like ontologies and XML as found on the Semantic web (Wiktionary).

3. DESIGN ARCHITECTURE

As shown in Fig. 1, our architectural design includes three main components which are web application/Pycharm Django, OWL RDF/API, and Midemo Deficiency Monitoring Ontology (MIDEMO). Each of the architectural components is being discussed in the subsequent sections.

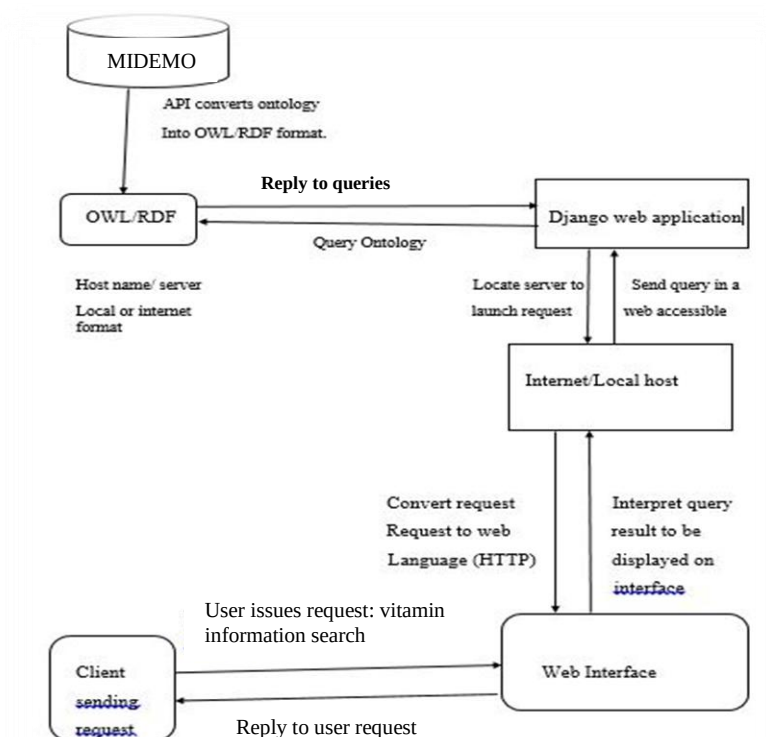


Fig. 1: Architectural Design

3.1 Micronutrient Deficiency Monitoring Ontology (MIDEMO)

The architecture is basically driven by the ontology, which provides the semantic basis that enables or generates precise information result on request. As there are no previously related ontologies on vitamins available from third party for re-use in this work, the ontology for Micronutrient Vitamins was developed from scratch.

All Information about the various types of Vitamins and Symptoms (Deficiency and Excess Intake) and so on are created as concepts, properties or relations and individuals in the system ontology which is named as the Micronutrient Deficiency Monitoring Ontology (MIDEMO). The ontology is coded in OWL form and developed by using protégé ontology editor. Fig. 2 and 3 depict some portion of the MIDEMO. The ontology start with “Thing” class that divided into various sub-concepts/sub-class such as “*Dietary Source*”, “*Effect*”, “*Solubility*”, “*Interactions*”, “*Supplements*”, “*Recommended*”, “*Dietary Allowance*”, “*Tolerable Upper Intake*” arranged in class-subclass relationship. We used top down class hierarchy developmental approach.

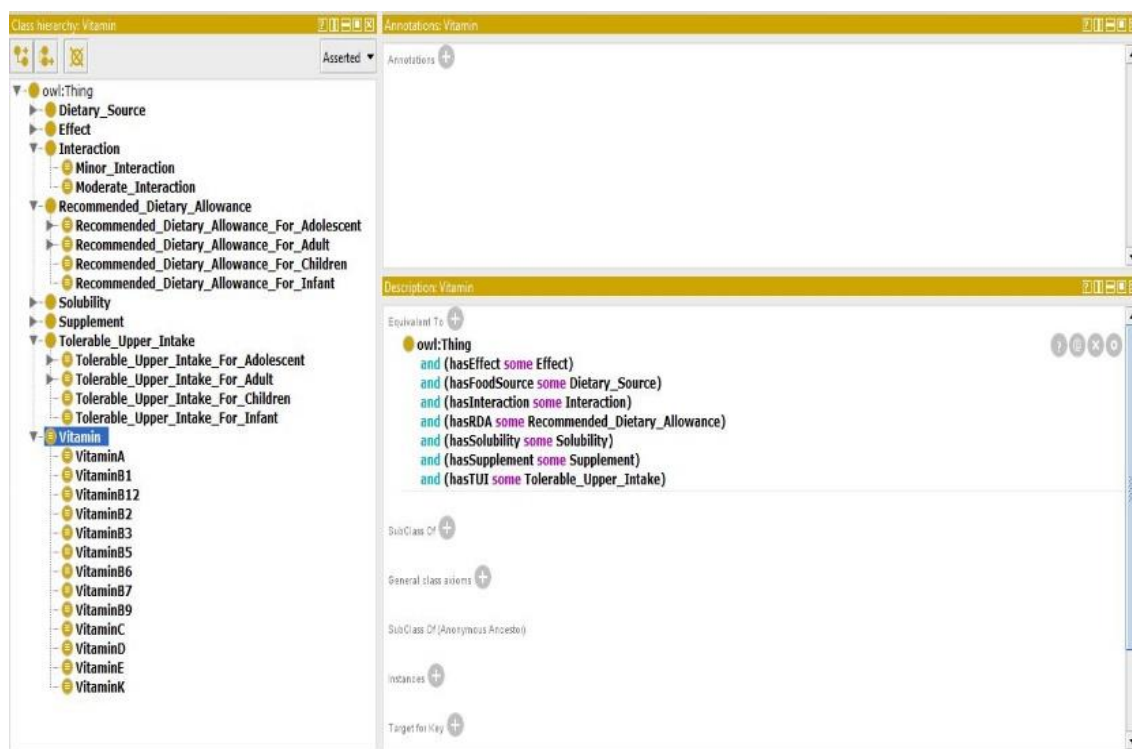


Fig. 2: The MIDEMO on protégé editor

In addition, based on these concepts and taking “vitamin” as the domain, many object-type properties are generated via *owl:topObjectProperty* such as “hasSolubility”, “hasEffect”, “hasTUI”, “hasToxicity”, “hasSymptom”, “hasDeficiency”, “hasFoodSource”, “has RDA”, “hasInteraction”, “hasSupplement”, “isFoodSourceOf”, “hasForm”. As shown in Fig 3, these properties are created in order to establish interclass relations and to interpret OWL individuals.

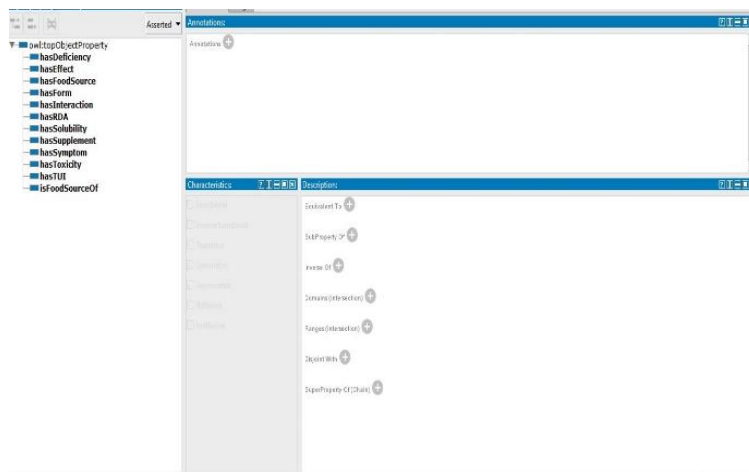


Fig. 3: Object Property of MIDEMO on protégé editor

Moreover, based on these concepts, some data-type properties are generated via *owl:topDataProperty* such as “*hasAge*”, “*hasRDAValue*”, “*hasTUIValue*” as shown in Fig 4.

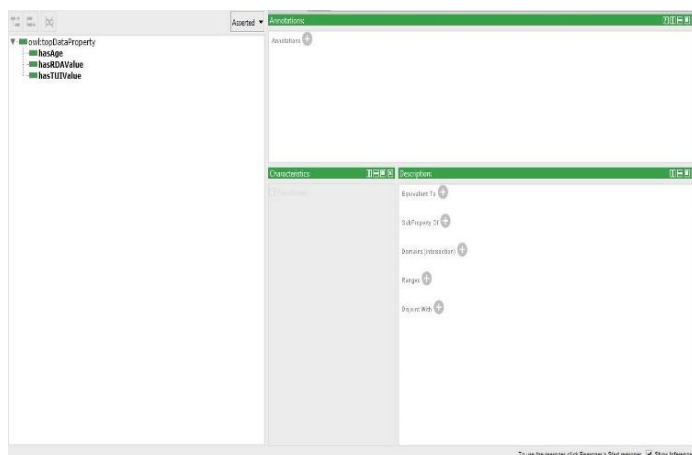


Fig. 4: Data Property of MIDEMO on protégé editor

Another semantically structured relation belonging to the classes is “*OWL individual*” declarations. This includes all instances that are related to individual classes. The Instances can be manually typed or retrieved from another source like database. As shown in Figure 5, the class “*vitamin*” in the ontology contains various OWL individual such as Abdominal Cramps, Abdominal Sweating, Abtaccept and so on. Figure 6 shows the ontograph display of graphical relationship between concepts in the ontology.

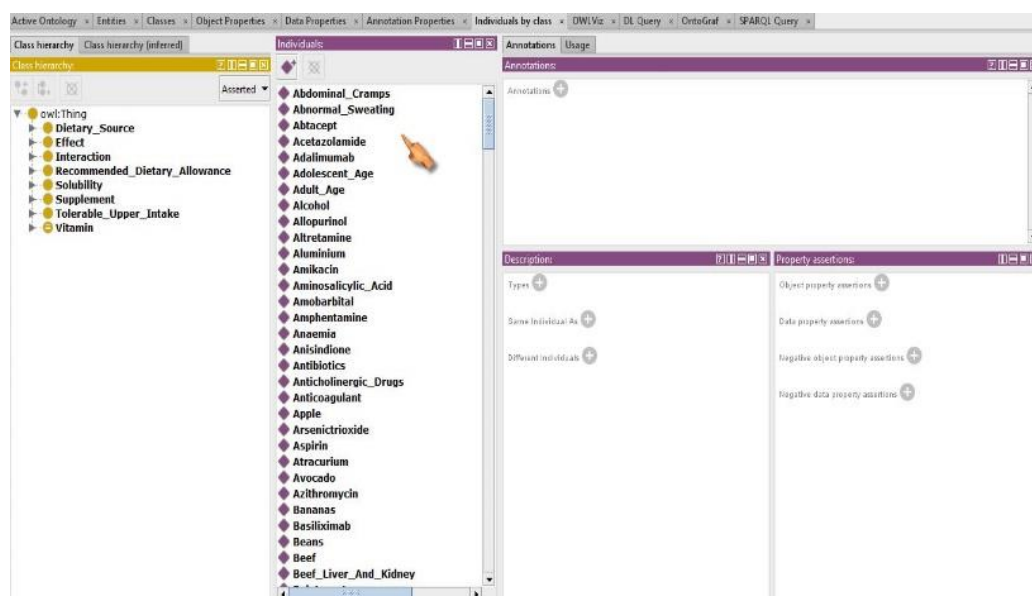


Fig. 5: Data Property of MIDEMO on protégé editor

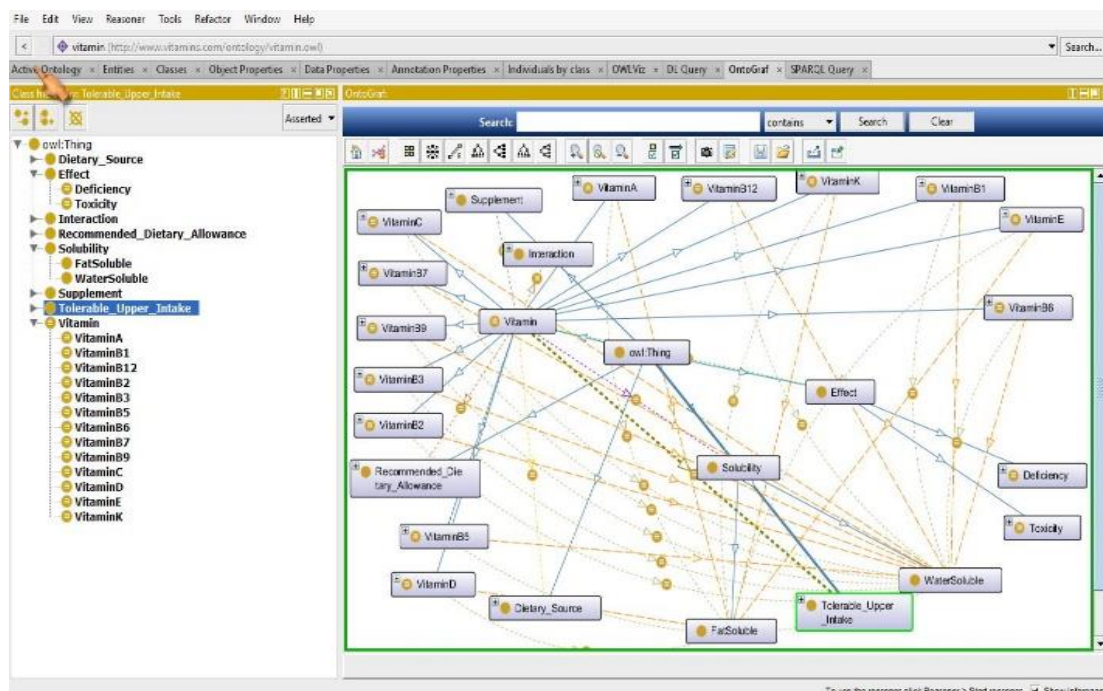


Fig.6: Onto-graphical relationship between concepts in the ontology.

3.2 Web Interface Design

The developed ontology requires an interface, being a web based in this work, to access the knowledge represented in it. Hence a web based application was developed, using Django in Pycharm integrated development environment (IDE). Django is a Python-based free and open-source web framework, which follows the model-template-view (MTV) architectural pattern. The application captures user requests which include asking for vitamins related enquiry. Figure 7 shows the search interface of the web application developed

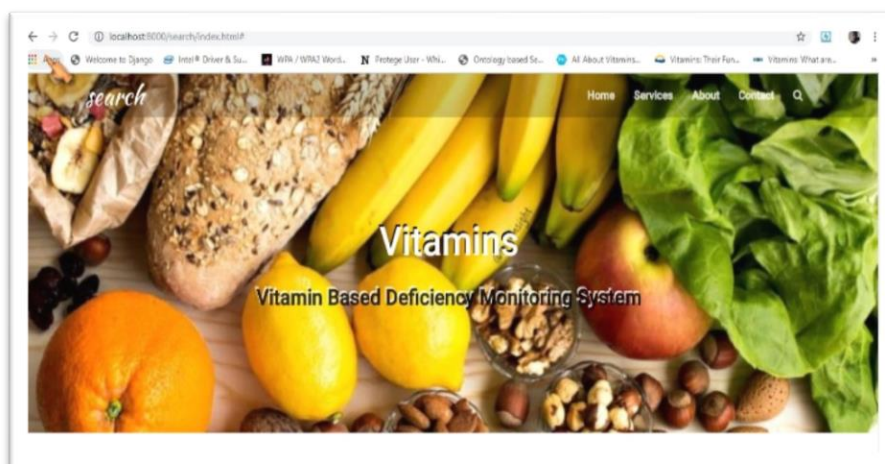


Fig. 7: Application Search Interface.

3.3 OWL RDF/API Resource Description Framework

The OWL RDF/API Resource Description Framework gives a high-level implementation of ontology concepts for integration into web accessible format.

4. CONCLUSION

This work has taken an intense look, into the intake of Vitamins in human beings. A lot of people are not aware of the recommended dosage, maximum daily dosage, effects and so on, when it comes to consumption of vitamins and minerals. From the representation of the different concepts and inferences used in this research work, awareness has been

created to users about the various vitamins available and what could lead to their deficiency, which could be deadly injurious to the body.

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