Article

Application of OASys approaches for Prophetic Food Ontology

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Abstract— **Ontology is an established knowledge representation enriched with a semantic interpretation that offered a mechanism for sharing mutual ideas and understanding among the members of a related domain. Semantic interpretation provided by the ontology has a structure that could facilitate the presentation of information for the users. This paper presents the ontology construction of prophetic food specifically for Dates and Goats Milk by using the OASys approaches. The ontology content focusing on the dates attributes, the developing stages of dates, defect and diseases of dates, health benefits, its compositions, and the chain of operation. Besides, the ontology content for goat's milk includes its nutrition, its cure for a medical problem, and the production. The construction of this ontology can be used to answer user queries, data integration to other applications as well as expand the ontology to a context mining semantic information retrieval search engine known as *Naqli Aqli* Integrated Search Engine (NAISE). This system is a query system based on integrated Naqli and Aqli knowledge heterogeneous sources on prophetic food.**

Keywords: **Ontology; Prophetic food, Dates; Goat's milk, Classes; Sub-classes; Individual; Properties; OASys approach, NAISE.**

I. INTRODUCTION

This paper is an extended version of a work published in third 'CAMP16. Ontology as a knowledge representation has contributed to providing the platform for sharing ideas and understanding among the members of a similar domain. Ontology is described as a significant method of classifying information complemented with an explicit specification of a conceptualization [1]. The definition of an ontology is enlivened by Zaikin [2] as a formal description of a specific domain with a standardization language that can be understood by humans and computers. Additionally, ontology also conveys the definition of the concepts and the relationships used to describe and represent an area of knowledge as well as depicts a formal model of the existences of things in a specific domain [3].

Studer, Benjamin, and Fensels, [4] reemphasized the meaning of ontology by highlighting that ontology is a formal and explicit specification of a shared conceptualization. Ontology can be seen as one of the progressing research areas, especially in the field of information retrieval. Ontologies are gradually employed to systematically organize information and facilitate interpretation and exchange of information semantically to enable human-computer interaction.

The retrieval process for certain information is very much related to how the information was organized. Anjewierden and Kabel [5] mentioned that establishing large bodies of data are necessary to enable satisfactory search results. This can be accomplished through the role of ontology as a formal and explicit specification of a shared conceptualization [6] and its capability as an effective tool in searching and retrieving information [7]. The ontology comes along with a representation of the knowledge through a set of concepts within a domain and the relationships built between those concepts. An approach to organizing texts by their conceptual content using ontologies has been discussed by Andreasen and Bulskov [8].

In this research, the Prophetic Food ontology of as one of the subsidiaries under the agriculture domain has been constructed. This ontology is constructed to serve the purpose of ontology from the aspect of prophetic foods domain that has a significant contribution to the Muslims life.

II. Previous Works

Many established ontology works have demonstrated the benefit of ontology implementation within the knowledge organization. Among others, a work by Yang and Gao [9] has proven that the application of the ontological approach within their work on disease management has improved the effective retrieval and access of the heterogeneous information available on the web.

Ontology supports knowledge acquisition and its retrieval process significantly and makes them becomes more intelligent [10]. Furthermore, the implementation of ontology could accelerate the information exchange in an efficient way [11]

Ontologies in the agricultural domain are not new. The work on this domain has been diverse and arising from year to year. However, the ones that are specifically built in the agricultural domain are still noticeably scarce for a specific group of species. Among the related work is the Durian ontology was developed by using the modified ontology [12]. Besides, there was an Agricultural Ontology focused on building ontology prototypes for plant production especially in the case of Thai rice [13]. A work by Kang and Gao on the Agriculture domain has recognized the intelligent searching resulted from the use of ontology technology [14]. Besides, Crop ontology was built based on the vocabulary provided in AGROVOC. This ontology was built to serve the farmers' needs for agricultural information [15]. There is also an ontology on dates but focusing on different aspects of date fruit such as quality profile and products constructed from the view of traditional Omani's life [16]

III. Dates

Dates have its vital background in Islamic history, be it from the medicinal aspect, production, health benefits, and many more. Since it was among the fruits that were mentioned in Al-Quran and also in Hadith, and eaten by the Prophet Muhammad (Peace be upon Him), it has a special relation and contribution to the Muslim lifestyle.

Several Quranic verses reflect the significance of Dates. Moreover, the date is honored as one of the blessings of Paradise.

"Do not grieve! Your Lord has placed a small stream at your feet. Shake the trunk of the palm towards you and fresh, ripe dates will drop down onto you. Eat and drink and delight your eye" (Quran,19:26)

Significance of Dates are also highlighted in several Hadiths for example:

"A family which has dates will not be hungry" Saheeh Muslim", Kitaab Al Ashribah, chap. 22, Book 22, No. 5078)

"The date that is from high (branches) is a cure" (Saheeh Muslim and Musnad Ahmad)

In this paper, the ontology work was built for the Dates as one part of the prophetic foods domain by focusing on the

Dates' attributes, the developing stages, defect and diseases of dates, health benefits, its compositions, and the Dates chain of operation.

IV. Goat's Milk

Similar to Dates, Goat's milk has a fundamental background in Islam. Several proofs are mentioning the goat's milk in hadith. Even recent research has revealed that the demand for goat's milk is escalating especially among Muslims since it is considered as one of the foods consumed by the Prophet Muhammad (Peace be upon Him) (17). General highlight on milk is declared in the following Quranic verse:

"And verily! In the cattle, there is a lesson to you. We give you to drink of that which is in their bellies, from between excretions and blood, pure milk; palatable to the drinkers". (Quran, 16:66)

Besides, Prophet Muhammad (Peace be upon Him) was also reported to have been pleased when once drinking goat milk (Saheeh Muslim No.4984). In this ontology work, the content for goat's milk-covered its nutrition, its cure for a medical problem, and the production.

V. Methodology

In building an ontology, various methodologies have been used to create ontology, such as by using 101 Methodology, TOVE, Methodology, OASys Methodology, and ENTERPRISE. These are among the prominent methodologies in constructing ontology [18]

Ontology development is a state of the art rather than a science [19] thus there is not a single correct ontology methodology to construct ontology [20]. This ontology on Prophetic Food was developed using OASys approaches simplified by Bermejo [21] which was indirectly developed based on the Methodology method. This guideline is relatively simple and straightforward and a way to present the Dates and Goat's Milk information more clearly. OASys offers improvements on the knowledge sharing and reuse between developers.

i.   The first step in ontology creation was to determine the domain and the scope of the ontology to be built. Therefore, among the basic questions to be answered are:

a.   What is the domain of the ontology?
b.   What is the use of the built ontology?
c.   Who will use the ontology?

For the Prophetic Food ontology, Dates and Goat's Milk are the current domain as part of the prophetic foods subsidiaries. The ontology will provide access to the concepts and knowledge representation related to dates and goat's milk. The ontology is intended for knowledge reservoir through the integration of *Naqli* (knowledge derived from Al-Quran and Hadith) and *Ali* (knowledge derived from human understanding) knowledge from heterogeneous expertise and sources.

ii.   The second step is to know the sources: documents, experts, and existing ontologies.

a.   Know the documents as the sources of the Dates and Goat's Milk information.

b.   Know the experts related to the Dates and Goat's Milk domain.

c.   Know the ontologies of the similar Dates and Goat's Milk domain to assist in analyzing the further criteria to be expanded and enhanced. In this case, existing ontology on dates was built from different viewpoints and different purposes.

Consequently, the steps in building the ontology were shown in Figure 1.
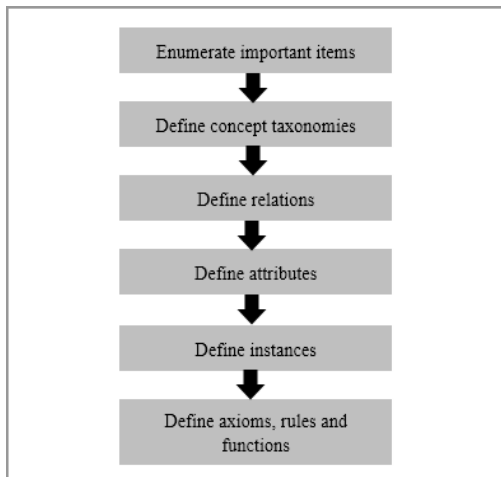
Fig. 1 Steps in building ontology (OASys Approach)

The process of creating ontology was initiated with the process of enumerating the important terms within the Dates and Goat's Milk domain. This step yields the taxonomies of classes and subclasses in the ontology. Next, the list of concept taxonomies was defined. This step produces classes and sub-classes.

Then, the proper relations were defined as well as the object properties and the data properties. Next, the component of the ontology content was assigned with the suitable type of attributes where applicable.

Afterward, the instances or individuals as the main component of ontology were also defined. Individuals are the members of the classes and subclasses. And subsequently, the axioms, rules, and functions were defined whenever required in the built ontology.

VI. RESULTS

This section presents the outcomes of the constructed ontology of the Prophetic Food domain based on the OASys approach. Based on the steps in the previous section, all the main elements of the ontology were created based on the Date Fruit Taxonomy and Property Definition [22]. They are as follows:

Classes and Sub-classes

Figure 2 shows the classes and sub-classes built within the Prophetic Food ontology. These two components of ontology are among the main concepts within the Dates and Goat's Milk domain.
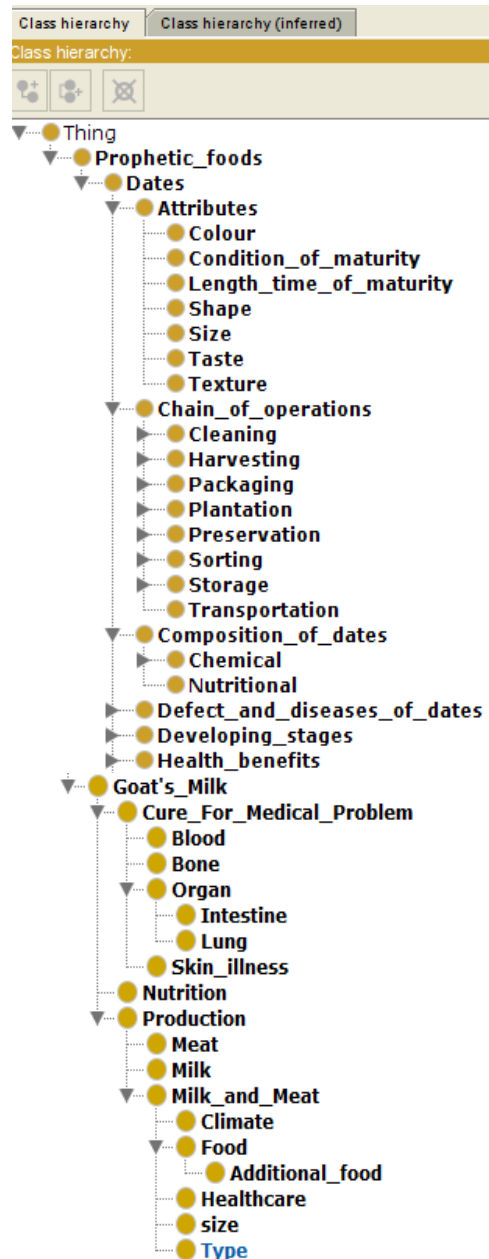

Fig. 2 Classes and Subclasses for Dates and Goat's milk

Individual (Instances)

As mentioned in the previous section, instances also known as individuals. Individuals are the members of the classes and subclasses. For instance in the Prophetic Food ontology, under the class of type of Dates, the members within the class grouped all the types of Dates available such as Halawy, Hababouk, Zahdi, Nour, and many more. While the example

for goat's milk subsidiaries, under the class of cure for a medical problem specifically for blood medical problem, it has listed out instances such as Anemia, Cancer, Jaundice, and Insomnia.

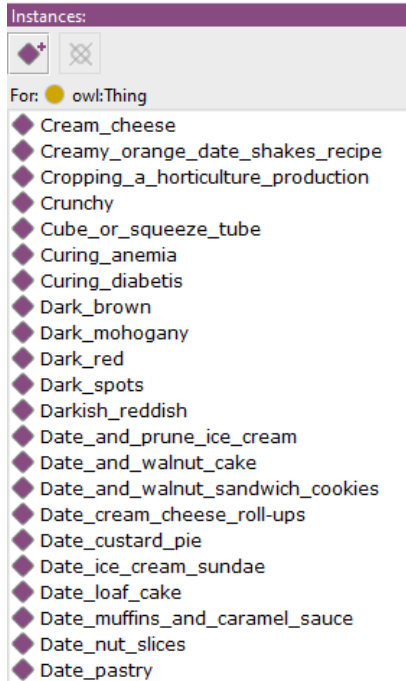Figure 3 demonstrates the individual's built-in Prophetic Food ontology.

Fig. 3 Individuals

Object and Data Properties (Relations)

Object properties are also known as relations or slots in some ontology editor version. Protégé as the applied ontology software of Prophetic Food ontology, object properties, and data properties term were used. Object properties are used for the generic relationship between two individuals in the ontology. Data properties are used in a specific alphanumeric type of relationship which describes relationships between individuals and data values [16].
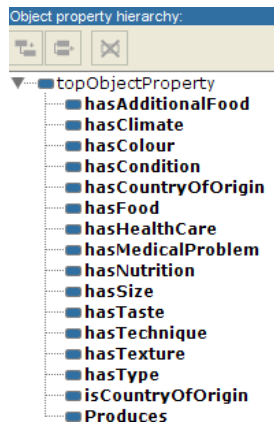

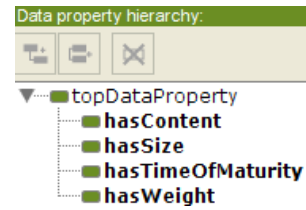Fig. 4 Object properties for Dates and Goat's Milk domain

Fig. 5 Data Properties for Dates and Goat's Milk domain

Figure 4 and 5 displays the sample of the object properties and data properties built in the Prophetic Food ontology. Figure 6 until 8 visualize the Prophetic Food ontology from various aspects.
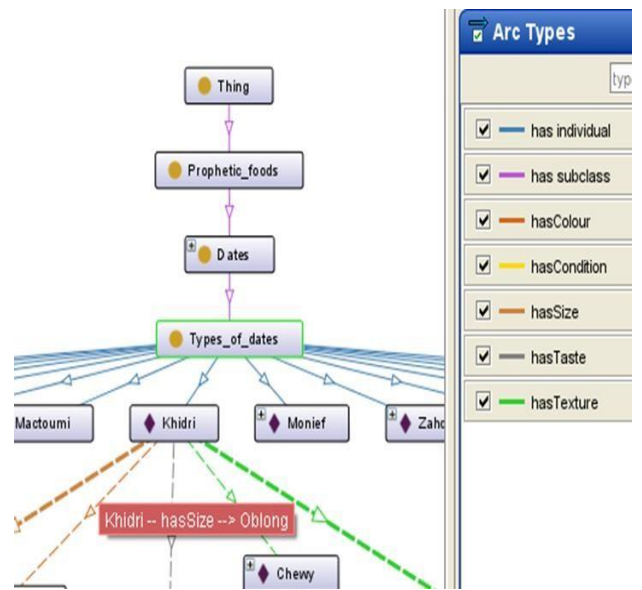

Fig. 6 Sample of Visualization of properties (relations)

Table 1 displays the total of each main component within the Prophetic Food Ontology built. Ontology metrics feature in Protégé software signify the statistics of constructed content within the ontology in general. Axioms are the established propositions created within the ontology. The way they were created as the main component built within the ontology was mentioned in the previous section.

TABLE I

LIST OF DATES ONTOLOGY METRICS

ONTOLOGY ITEMS	TOTAL COUNT
AXIOM	3183
CLASSES	489
SUB-CLASSES	489

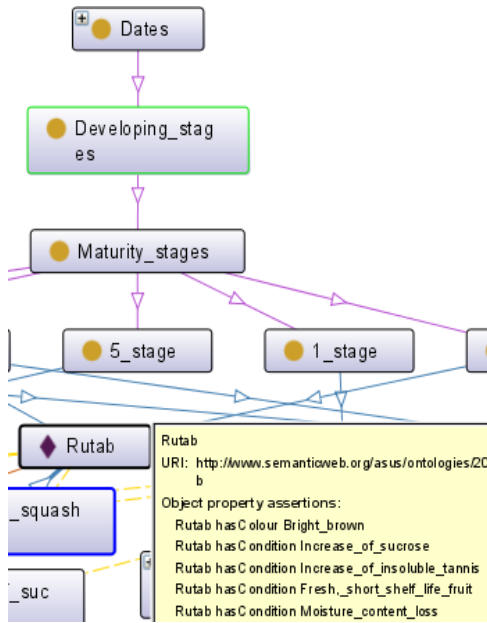| ONTOLOGY ITEMS	TOTAL COUNT
OBJECT PROPERTY	17
DATA PROPERTY	5
INDIVIDUAL	796

Fig. 7 Dates hierarchy and its sample of assigned properties in Prophetic Food ontology.
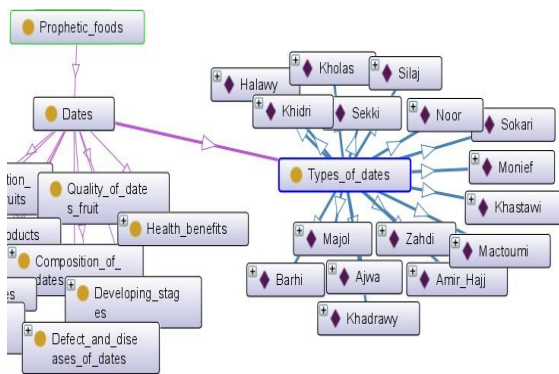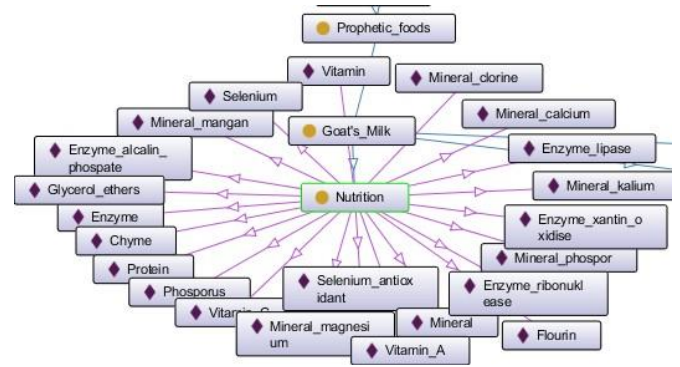

Fig. 8 Visualization of Dates Ontology Content

Fig. 9 Visualization of Goat's milk Ontology Content

VII. CONCLUSIONS

Information on Dates and Goat's milk as part of the prophetic food domain can be well arranged and managed by using the ontological approach. It easier way to browse for the necessary information if the information related to the aspects of dates are presented based on classes, subclasses, properties, and instances platform. The hierarchy of concepts on the prophetic food ontology domain is presented.

The construction of ontology on the prophetic food domain can be further expanded to other types of beneficial prophetic foods, and accompany by necessary queries.

This ontology on Dates and Goat's Milk has been expanded to a context mining semantic information retrieval search engine known as *Naqli Aqli* Integrated Search Engine (NAISE). This system provides knowledge reservoir through the integration of *Naqli* and *Aqli* knowledge from heterogeneous expertise and sources such as Al-Quran, Hadith, Islamic manuscripts, and scientific articles related to Dates and Goat's Milk. NISE provides a parallel corpus in three languages that are Arabic, Malay, and English. Queries can also be in these three languages.

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