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Ontological Model Development Work Process

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ABSTRACT

Indigenous Knowledge (IK) has known to be long exist and used by the local people in certain environments in making their living. This knowledgeis vital and crucial for the sustainability and the existence of a society and therefore need to be preserved from extinction. Currently, most knowledge organization models are static and difficult to be managed in a dynamic environment. To develop a dynamic and comprehensive ontological model through a heuristic and hybrid method thatcombine taxonomy and Semantic web technology requires a structured work process. For this purpose, a work process for ontological model development is constructed. The development of the work process could be used as a reference point by organizations towards nurturing a knowledge society which is important to our socioeconomic. In the future, the ontological model development work process could be replicated for other domain's use particularly for knowledge preservation.

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INTRODUCTION

Indigenous Knowledge IK) is defined by Warren *et al*. (1991) as the knowledge that being used by the local people in certain environments in making their living. This statement is in agreement with the definition by Davis (1991) and Ngulube (2002) which stated that IK generally means as a traditional practices and culture which involve the beliefs, rituals and expressions of cultural values. Earlier, the emphases of IK are on its technicality. Currently, it had gone beyond that technical interpretation. IK at present includes the cultural knowledge such as the political, social, economic and spiritual aspects of life (Langill, 1999). The culture of certain geographic area had become a vital aspect in determining the IK questions. For instance, spiritual beliefs are one of the IK areas. It concerns about how certain nature may influence the resources that being managed. Previously, western scientists have in general rejected the IK and claimed it as unreliable, non-quantitative, and unempirical (Berkes, 1993). However today, the scientific importance of IK is recognized and valued by those carrying out research in areas that are inhabited by indigenous peoples (Sommer *et al.*, 2004). Educators also are aware of the importance of using IK in the classroom and there are currently many efforts to develop culturally relevant curriculum for classrooms all across the globe. Using IK in science lessons, activities, and class projects give an added depth and meaning to difficult concepts, and build communication and respect with the community (Alaska Rural Systemic Initiative, 2002).

There are lots of threats, limitations and issues that make IK difficult to be preserved. According to Western Australian Law Reform Commission (2006), the deficiency of protection on a nationwide level by all means of government becomes one of the major factors. Besides that, the influence of modern technology and education also becomes one of the threats to IK as lots of new education systems are not considered IK as the knowledge that is needed to be protected (Ngulube, 2002). Moreover, the collection of IK information needs more of labour resources and time consuming which is really costly if needs to be maintained (Lawas and Luning, 2006). Hence, a proper storage and management is very important in order to make the information available and accessible when needed. There is no specific way to preserve the knowledge itself but an appropriate search and retrieval mechanism such as an ontological model is important and needed to describe the concept of the IK which is one of the tacit knowledge which belongs to individuals. The necessities then are needed to preserve the IK which is scattered and unorganized (Haron *et al*., 2010, Hart, 2010, Haron and Hamiz, 2013).

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The development of ontological model can be done using various knowledge modelling tools. However, the existing ontology development processes are not being catered towards casual web ontology development, a notion analogous to the standard web page development(Vanitha *et al*., 2011).Thus, this work aims to develop adynamic and comprehensive ontological model work process through a heuristic and hybrid method which combining taxonomy and semantic web technology. The combined features of ontological model and semantic web technology to provide a more balanced solution for ontology mapping and information structuring thus assist users in retrieving information easily.

Knowledge Modelling: Ontology:

Previously, IK are preserved and being disseminated through transfer method, whichone of the ways is from mouth to mouth. Since the transfer method is hard to maintain, the paradigm has been transferred to modelling method. Knowledge modelling is significant and important in order to understand the working instruments within a knowledge-based system. The instruments that are involved are the tasks and methods which involved concluding the area and schemas of knowledge being explored. The central of knowledge engineering are coming from the conceptualization of a model (Wielinga *et al*., 1997; Schreiber *et al*. 1999). Modelling contributes to the understanding of the source of knowledge, the inputs and outputs, the flow of knowledge and the identification of other variables such as the impact that management action has on the organizational knowledge (Davenport and Prusak, 2000).As the theory has shifted from the transfer method to the modelling approach, knowledge modelling has become an essential aspect in the process of developing knowledge management systems. With the modelling approach, systems development can be done faster and more competent through the re-use of existing models for different areas of the same domain. Therefore, understanding and selecting the modelling technique that is appropriate for different domains of knowledge will ensure the success of the knowledge management system being designed.

In real-world application, information is often fuzzy or confusing (Zhang *et al*., 2008). Hence, (Yazici and George, 1999) came out with numerous proposals of integration process to widen database model that maintains the ambiguity and vagueness of real-world application. The proposal will then be extended to ontological model which if been realized, will contribute much to certain area of research. Philosophically, ontology can be defined as the study that concerned with the existence of itself (Flew, 1979). However in the IT context, it can be described as an explicit specification of conceptualization (Gruber, 1993). In short, ontology intends to capture consensual knowledge in a nonspecific way which in can be reused and shared among the software applications and by the group of people (Corcho, 2004).The ontology defines a general term for researchers who need to distribute information in a domain. It comprises a machine-interpretable definition of fundamental concepts in the area and associations among them. The importance to develop an ontological model is to share a common understanding and sensible structures of information, make domain hypothesis explicit, provide categorization structure, enable reuse of domain knowledge, analyze and separate domain knowledge from the functional knowledge and prevent irrational structures of knowledge

The role of ontology in Knowledge Management (KM) processes aids in knowledge creation, storage, retrieval, transfer, and application together with performance improvement (Alavi and Leidner, 2001; Sasson and Douglas, 2006). The adoption of ontology also had been used widely nowadays; for example, the concept of analysis of medicine, concept of recipe plus the scheduling ontology is representing food industry and analytic hierarchical process from tourism (Nasir and Noor, 2010). There are four broad categories of ontology which include static, dynamic, intentional and social. Static ontology explains static features of the world such as what things exist, their attributes and relationships. This ontology is not insignificant as for certain applications; it is functional in order to make a distinction between dissimilar modes of entity's existence. The dynamic ontology in the other hand describes about changing aspects of the world. In this category, the temporal information is often needed when describing dynamic worlds. Besides that, intentional technology includes the word of motivations, intents, goals, belief, alternatives, choices and much more. It allows interchange realities to be uttered and consistent about (Jurisica *et al*., 1999). Social ontology covers social setting, organizational structures, or shifting networks of alliances and interdependencies. It is also of interest in distributed artificial intelligence which has been formalized using certain logic.

Developing ontology is similar to the essential set of data and their organization for other programs to use. Problem-solving methods, software agents and domain-independent applications use ontology and knowledge bases built from the ontology as information. There are a few approaches such as hybrid and task based approach to develop ontologies. However, declarative approach to ontology is needed for the knowledge preservation because ontology is a method where the domain is represented in structured and may provide the benefits to those who implemented it (Almeda and Barbosa, 2009; Geetha and Iyengar, 2010).

Work Process & Experiment:

Since the work process is not properly structured, hence, a structured work process is proposed and itincludes the iterative step by step on how to develop an ontology in any domain dynamically together with the

hybrid method of integrating the ontological modelwith semantic web technology. The steps involved are Concept, Domain, Sub Domain, Instances (Raw Data, Analysis, Category Aggregation, and Establish Pattern), Relationship, Axiom, Ontology Model, Inference Engine, User Interface and User as illustrated in Fig. 1.

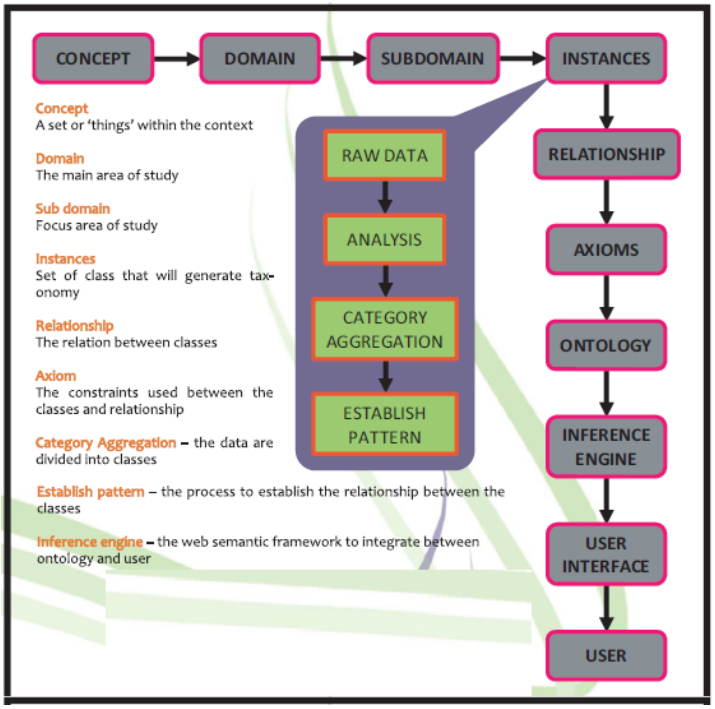

Fig. 1: Ontological Model Development Work Process

The main components of ontology are concepts, relations, instances and axioms. A concept represents a set or class of entities or `things' within a domain. In ontology development, 'thing' must be at the top of the hierarchy of the research area. Then, the domain has to be determined. Domain is the main subject or area of research that needs to be explored by the researcher. After choosing a domain, there must be a sub domain (Odell, 1998). The researcher has to choose the sub domain area as the targeted research must have the specific part to be focused on.Once the focus research area is verified, the data collection process starts. From the data collection, the biggest part of the work process starts with developing the instances. Instances are the 'things' represented as the concept (Brachman *et al*., 1991). In this stage, the process can be divided into two more steps. From the raw data collected, the Category Aggregation step will determine which data will act as the super classes, and which will become the subclasses.From the aggregation of the categories, hence, the taxonomy of the data will be created. The data will stay as taxonomy if there is no relationship to link those classes after its being categorized. Then, the Establish Pattern step will helpfind out the possible relationship needed to link the classes in the taxonomy. Once the relationship is created, then, the classes will be linked together with its axioms. In certain cases of ontology, the axiom is needed as it is used to constrainvalues for classes or instances. The most used axioms are 'some' and 'only'. The 'only' axiom means that the subclass will only have a relationship with only one other subclass and the 'some' axiom means that one subclass can have many relationships with the other subclasses. Just like in database relationship concept, 'only' is equal to one-to-one relationship and 'some' is equal to one-to-many relationship. Once the concept, domain, instances and relationship are established, hence, the data that has been modelled can be called an ontology model (Staab and Maedche, 2000). Once the ontology is created, hence, the hybrid part of the ontological model with the semantic web technology will take place.

Semantic technology is a common term used for any software that engages any type and level of understanding the meaning of the processed data it deals with. The technology that is suitable for dynamic database which is getting from many sources to manage is called as semantic technology (Sheth and Ramakrishnan, 2009). Many semantic web applications use a framework of integrated components. The framework provides storage and retrieval of RDF information and interpretation of OWL semantics. The common semantic web frameworks are Jena semantic web framework and Sesame RDF framework. But, in this prototype development, Jena framework is used with Java EE. Each component in this prototype describes as follows:

a. User interface – This is the situation where interaction between humans and machines occurs.

b. Inference engine – This component will infer knowledge semantically. It consists some encoding of rules production of OWL/XML. The engine here is where the Jena framework is connected to Java EE Web application to process the ontology model in .owl file.

c. Ontology model - It includes the information about the data chosen that had been modelled.

A dialogue is conducted by the user interface between the user and the system. User requests for information and the system then attempts to provide information inferred by the inference engine after examining the ontology model. The user will have to interact through the user interface before communicate with inference engine and ontology model. The ontology model will act like a database where it holds all of the information regarding the postpartum dietary. The query to retrieve the information in an ontology model through the Jena framework is SPARQL.

The work process as proposed can be tested by developing an ontological model that will be integrated with semantic web technology. In this research experiment, the work process is followed as below.

a. **Concept** – the concept chosen is to preserve Malay indigenous health knowledge.

b. **Domain** – the domain that is chosen in Malay indigenous health knowledge is regarding the dietary during the postpartum period. During the postpartum period, the affectionate death and mother's disabilities have always been neglected. It is believed that the insufficient considerations or even an absent care being offered to women and their newborns at home or in health conveniences provides a little role to their well-being and forms a fragile basis for their future healthiness. The less care the mother gets, the poorer the quality of getting a better health. It includes the early detection and sufficient management of struggles and ailment. Therefore, the qualities of postpartum care are long-term ventures in the future well-being of women and their newborn (WHO, 1998). Hence, that's the reason why the preservation of postpartum diet is important.

c. **Subdomain** – since the dietary consists of so many foods, hence, the focus is regarded on the types of fish and its vitamin and minerals contains by the fish. The vitamin and minerals are considered the nutrients that can be enhanced in the mother's body after postpartum by choosing the right food. The study in 2005 Malaysian Recommended Nutrient Intakes (RNI) had classifies individuals into 33 age-gender collections and lists on a daily basis of the requirements for 15 nutrients. The nutrients included the Protein, Calcium, Vitamin A, Carbohydrate and so forth. There are much instructive involvement has focused on the pregnancy linked nutrition and health inconveniences (Boyd and Windsor, 2003; Rigotti *et al*., 2006). Normally, such edification programs are often not being preserved during the postpartum period. Postpartum period received not much consideration as compared with pregnancy and childbirth (Albers, 2000).

d. **Instances** – the steps in the instances can be zoomed in as:

i. Raw data – this data is recorded from the interview with the Malay traditional midwives regarding the foods taken, dietician and medical doctors on the topic of the nutrients.

ii. Analysis – once the data is recorded, it has to be analyzed to make sure that the data contains no error and at this point, but at this point, the data are still unorganized.

iii. Category aggregation – to make the data organized, hence, categorical aggregation is very important as after the data are being categorized, taxonomy for each class will be created. In this stage, taxonomy of fish, vitamin and mineral is created as shown in Fig. 2.

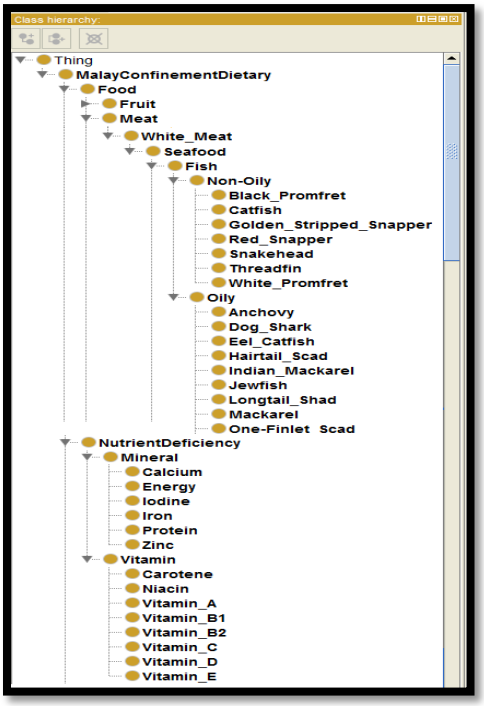

Fig. 2: Taxonomy of Fish and Nutrient Deficiency.

Based on Fig. 2, the taxonomy of fish is taken from the categorization by Weia (2013), USDA (2002), and Bennion and Scheule (2010) and the category of Nutrients was taken from the dietician and medical doctors.

iv. Establish pattern – the taxonomy will become ontology if there is a relationship that can relate the classes together. In this research, the relationship being established is *isEnhance*.

e. **Relationship** – since the relationship *isEnhance* is established, in this stage, the classes have to be linked together with the relationship. In this research, class Fish *isEnhance* class Nutrient in the ontology model.

f. **Axiom** – certain type of fish contains more than one vitamin and minerals, hence, it can enhance more nutrients in the mother's body during postpartum. In this research, the axiom used between class Fish and class Nutrient is Fish *isEnhance* some Nutrient Deficiency.

Once all of the steps are done, then, the ontological model now has been created. Now, the hybrid part is started. The ontological model has to be integrated with the semantic web technology, Jena framework. The codification on the program will let the user interact with the data on the ontological model through the user interface.

RESULT AND DISCUSSION

The steps in the work process will give two sets of result. The first six steps in the work process will give the ontology model. Once the concept, domain, sub domain, instances and the relationship has been established, then, the ontological model is ready. The ontology model has been created using the knowledge modelling tool which appropriate and the data needed from the model can be generated manually. In this research, the ontological model of the fish that were eaten during postpartum dietary with its own vitamin and mineral that contains by the fish is shown in Fig. 3.

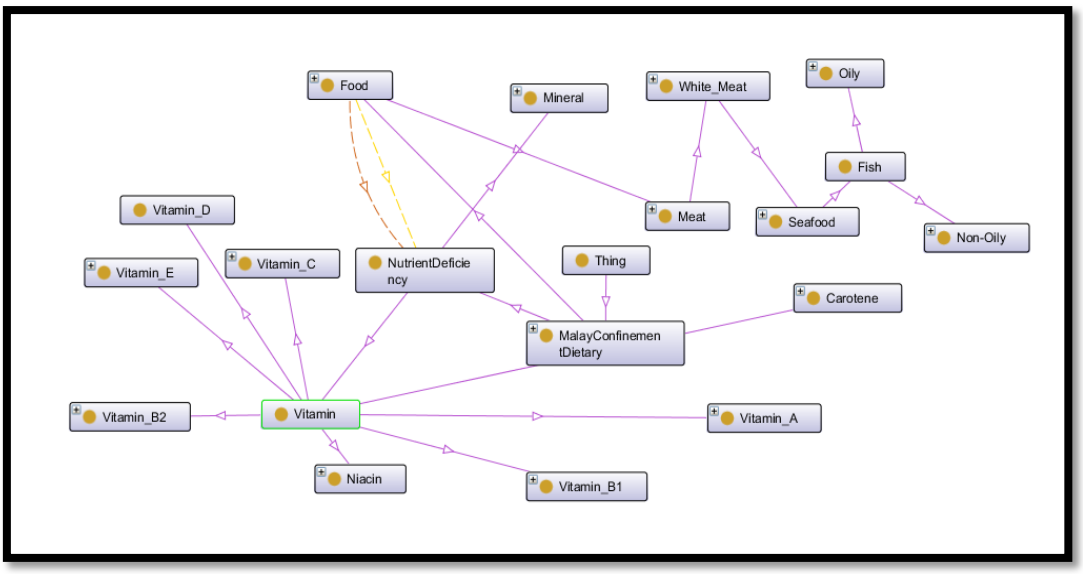

Fig. 3: Ontological Model of Fish and Nutrient Deficiency.

Based on Fig. 3, the taxonomy of Fish starts with Food class. Inside the food class, there are White Meat class, then Seafood class and finally the Fish class. Inside the Fish class, the Fish can be categorized into Oily and Non-oily fish. For Nutrient Deficiency class, there is Vitamin and Mineral class which can enhance the nutrient loss in postpartum mother's body.

By using the hybrid method of ontological model and semantic web technology, a web prototype is developed and the data in the ontology model can be retrieved by the user through the web user interface as shown in Fig. 4.

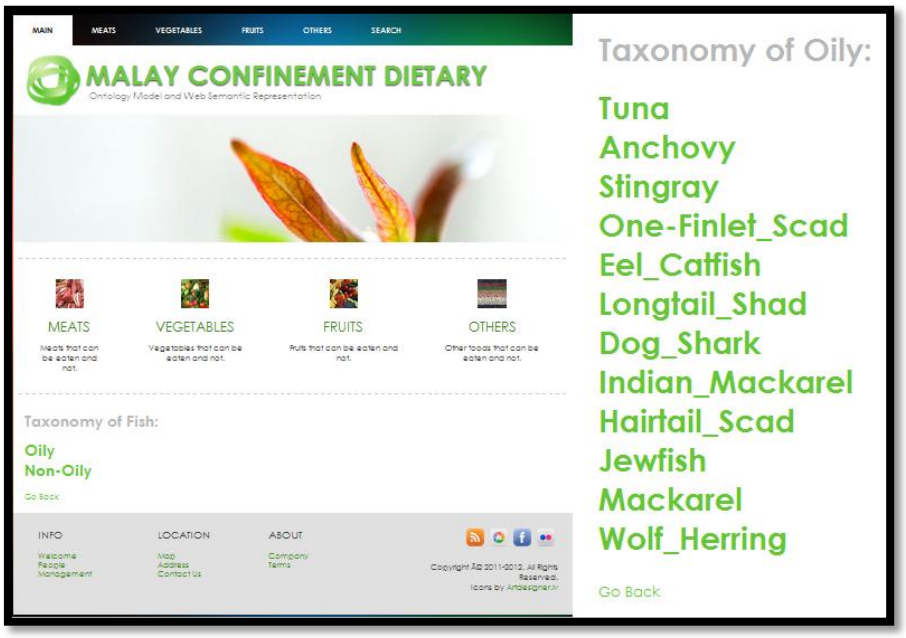

Fig. 4: Web prototype of ontological model and semantic web technology representation.

Based on Fig. 4, the data about the Fish and its nutrients can be retrieved through the web interface. The web prototype is actually using a semantic web technology where, the Jena framework is used to connect between the ontological model and codification of the program.

By having the work process proposed, the development of ontological model will become easier as there is a detailed step by step process being outlined. Besides that, this work process able to support a dynamic environment of any domain chosen to be modelled and make it more reliable. Most of the ontology model development is just stop at the model part without integrating it with any semantic technology for easier data

retrieval but the work process proposed here detailed out the process of integrating the ontology model with semantic web technology. By having the work process, the ontological model development can be carried out with the hybrid method combining it semantic web technology will ease the process of decision making.

Conclusion:

Indigenous knowledge is crucial as it is used by the local people in certain environments in their daily lives. Since the knowledge is tacit and scattered, the method used for the preservation must be done in a correct manner and organize. The ontology is an example of knowledge modelling which represent the knowledge in a manner which a computer can facilitate. However, the work process to build the ontological model is not being structured as it is being represented in a text of the guidelines. Hence, the work process as proposed in this research give a dynamic step-by-step approach for developing an ontological model together with the integration with the semantic web technology. This work process can provide a more objective solution for ontology mapping and information structuring thus assist users in retrieving the knowledge easily.

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