CERTIFICATION OF APPROVAL

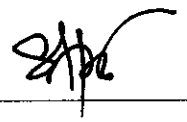
Developing Ontology for Malaysian Tourism

by

Nor Laili Bt Safiin

A project dissertation submitted to the
Information Communication Technology Programme
Universiti Teknologi PETRONAS
in partial fulfillment of the requirement for the
Bachelor of Technology (Hons)
(Information CommunicationTechnology)

Approved:

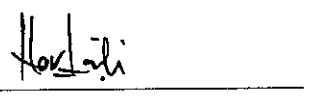


(Ms. Syarifah Bahiyah Rahayu Bt. Syed Mansoor)
Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
June 2006

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



NOR LAILI BT SAFIIN

ABSTRACT

This project describes on the development of *Malaysian Tourism Ontology* and the importance of ontology to make knowledge assets intelligently accessible to people in organizations. Ontology is a long-lived conceptual model that can be used in multiple applications, providing good opportunities for reuse and interoperability. Ontology defines a common vocabulary for researchers who need to share information in a domain. It includes machine-interpretable definitions of basic concepts in the domain and relations among them. The purpose ontology being develops because to share the common understanding of the structure of information among people and among software agents. It can enable re-use of domain knowledge and can avoid "re-inventing the wheel". If the ontology already exists, it cut short the development part and just makes use of it. Ontology is aim to introduce standards to allow interoperability in order to create a machine readable. Moreover, ontology is used to capture knowledge, create a shared understanding between humans and for computers, make knowledge machine processable and makes meaning explicit by definition and context. Domain knowledge need to be analyzed in order to make it more meaningful and towards creating a machine readable program. This ontology is created using Protégé 3.2 Beta, an integrated software tool used to develop knowledge-based system that includes a knowledge base about a domain and programs that include rules for processing the knowledge and for solving problems relating to the domain. This application is developed using Protégé-3.2, an advanced technology tool use in problem solving and decision-making in a particular domain or field of knowledge.

ACKNOWLEDGEMENT

First and foremost, I would like to express my gratitude to Almighty Allah s.w.t, without His will, this final year project would not be accomplished. I would also like to take this opportunity to convey my appreciations to all the people who has contributed directly or indirectly in the research and development of this project.

I would like to express my gratitude towards my supervisor, Ms. Syarifah Bahiyah Rahayu Bt. Syed Mansoor for helping me throughout the semester in delivering this project. Without her full support and contribution, I believe that I'm not being able to learn new things and broaden my knowledge. I really appreciate all the help that had been given to me.

I would also like to thank my friends and colleagues for being there and support me when ever I need some help. The passion that they project to me makes me more enthusiastic to finish this project and I am really thankful for all the advice and helps that they give to me. Thanks friends.

Not forgotten, my parents, Hj. Safiin Bin Yusoff and. Hjh. Habsah Bt. Hj. Mohd Adam for supporting me from the beginning. Thanks for all the advice and doa'. I am really grateful for having both of them beside me and support me all the time.

Last but not least, thanks again to all who had help me in finishing this project. I hope that their kindness will be rewarded by Allah s.w.t.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

1.1 Background of Study

Support for information and knowledge exchange is a key issue in the Information Society. The emerging of knowledge management contributes to the need of capturing the knowledge and re-uses it. Researchers had come out with ontology – a conceptualization of a domain into machine-readable format with the hierarchy of concepts and relationships that exist. This project paper introduces the use of ontology for Malaysian Tourism. The domain knowledge in which shared information is represented for this project is about Tourism and the scope is for Malaysia only. Since government, emphasize the citizens as well as the international visitor to visit Malaysia on 2007, therefore there is a need on developing ontology to represent the tourism itself in more detail. Ontology applied to the tourism data to make it more structured, easy to manage and understandable. Information about Malaysian Tourism is captured and display in hierarchy arrangement to make it more understandable and easier for user to make a searching with the exact keyword. User can have a clear view of tourism information. The visualized ontology adds more interactive features on it. Ontologies are increasingly becoming popular due to its potential to bring the web to its full potential [1] and make it more powerful. In large organizations, it has been recognized as a crucial success factor for survival, in combination with knowledge management.

Ontologies had the potential to facilitate the creation of semantic relationships between various pieces of relevant and useful information to enhance the learning experience. Ontologies gaining a lot of interest and many are being developed to provide a variety of knowledge services. In Artificial Intelligent (AI), ontology refers to an engineering artifact, constituted by a specific vocabulary used to describe a certain reality, with a set of explicit assumptions regarding the intended meaning of the vocabulary words [2]. Ontologies are becoming increasingly popular modelling schemas for knowledge management services and applications. Focus on developing tools to visualize ontologies is rising to aid the assessment and analysis. The research on ontology is becoming increasingly widespread in the computer science community [3] in the context of integration and representation of various knowledge resources in organizations.

1.2 Problem Statement

1.2.1 Problem Identification

The relevant knowledge items can appear from a huge number of different sources and in a variety of formats. The challenge here is to appropriately structure and interlink the available knowledge [4]. The exponential growth of online information on intranets and the Web leads to information overload. Time wasted in searching and browsing, and increase user frustration in searching for a concise words [5]. Neither individual minds nor collective culture seems able to cope with the unpredictable change and growing complexity. Stress, uncertainty, and frustration increase, minds are overloaded with information, knowledge fragments, values erode, and negative developments are consistently overemphasized [6]. The need for a structured knowledge and more precise result could reduce the symptoms. This is possible by automatic meaning-directed or semantic information processing of online documents by using ontology. The information or knowledge is written for specific purposes that may not reveal real knowledge or explicit conceptualizations. All textual analysis is a form of content analysis where the interpreter may or may not be imputing the correct conceptualization [7]. It is difficult to reconstruct the context - need to capture acquisition and design rationales. Most people agree that finding the exact information one is seeking on the web today is not as easy as one would hope [8]. One reason for this is that, answers to search queries typically are a rank ordered list of pages that may contain the answer to the query. The answers rarely are just the portion of the page that the search engine "thought" contained the answer to the query.

There are the need for knowledge acquisition, and representation, but the Information is not at one place. The knowledge is hard to capture and it is unstructured where normally it is in the mind of the people who interpret them. The tacit knowledge is hard to capture in order to make it explicit [9]. Perceivers

are tending to remember the knowledge by their own and the problems rise on how to capture the knowledge that he or she holds. The knowledge and expertise is difficult to manage, scattered and not according the hierarchy of diverse and information sources. Consequently, different information, spread over various sources, in various formats, and with non-matching semantics. Others problems that arise such as too much information out of context, it is difficult to discern high quality, relevant information from hearsay, inaccurate, unqualified, or outdated information [10].

1.2.2 Significant of Project

Knowledge Management (KM) involves the discovery and capture of knowledge, filtering, and arrangement of knowledge to support the sharing and reuse of formally represented knowledge. Even government wants to implement the knowledge management in our daily work activities. While KM proponents share this goal, organizations are still overwhelmed by the need to rapidly analyze and classify unstructured information. The rise for ontology is because of the conceptualization of specification. Why ontology is chosen because ontology is neither a catalog of concept nor database, but it is more on to make particular domain knowledge more structured instead of just presenting information to humans. Ontologies are different from metadata, database, and taxonomies. The conceptualization of relationship structure makes it different from others. This project aims to fulfill ontologies attribute such as share a common understanding of information among people or software agents. To enable reuse of knowledge therefore can avoid re-inventing the wheel and introduce standards to allow interoperability. To make explicit assumptions about knowledge and make it easier to change domain assumptions, understand and update inheritance of data. The last attributes are to separate domain and operational knowledge, so domain and operational knowledge can be re-use separately.

1.3 Objectives

The objectives of this research are as follows:

- To structured Malaysian Tourism information.
- To implement the ontology in a formal knowledge representation language.
- To use visualization technique to view or browse the ontology

The first objective is to make sure that the information is being presented in an efficient and effective ways and make it more accessible to the user. When the knowledge acquired is structured it can be manage easily. By implementing the ontology using an ontology editors such as protégé, automatically the ontology is accepted as a machine readable representation of knowledge.

There is an increasing need for ontology and there tools to graphically and interactively visualize such modelling structures to enhance their clarification, verification, and analysis. Graph visualization helps to browse and comprehend the structure of ontologies, analyze their network connections and observe changes.

CHAPTER 2

LITERATURE REVIEW AND THEORY

2.0 LITERATURE REVIEW AND THEORY

Knowledge Management (KM) is based in large part on systems that help users focus their attention on key information that is relevant, timely, and available on-demand. The preparation of this information requires processes for knowledge acquisition, knowledge engineering, and representation because knowledge and expertise are embedded within diverse and scattered information sources. Necessary to KM strategies is the act of imposing a structure on the knowledge acquired in order to manage it effectively. This is because most information is unstructured, does not fit easily into database models, and is at best difficult to manage [11]. Leveraging unstructured information is a chronic challenge for companies competing in today's economy. KM involves the discovery and capture of knowledge, the filtering, and arrangement of this knowledge, and the value derived from sharing and using this knowledge throughout the organization.

Recognizing that there are too many problem faces, then they come out with a simple question, "How are you going to categorize new information that's being emerging?" it can be very difficult to answer. Therefore, ontologies, in the other hand, categorize information; represent the most promising approach to solving the growing problem of information overload [12]. Ontology is a common vocabulary for researchers who need to share information in a domain. It includes machine-interpretable definitions of basic concepts in the domain and relations among them. The domain is the subject area and ontologies are, basically, systems of categories.

Ontologies are not a data schema, databases, or metadata. There are several differences between all those terms. A database is an organized collection of data stored in a computer in a systematic way, so that a computer program can consult it to answer questions [13]. While metadata are structured, encoded data that describes characteristics of information-bearing entities to aid in the identification, discovery, assessment, and management of the described entities [14]. Metadata describe data about data, meant as machine process able information for the Web. It is a systematic method for describing information resources, helps to improve their accessibility, and gives other useful resource information to support their maintenance. Thus, one key purpose of metadata is to facilitate and improve the retrieval of information. Taxonomy is just a classification of things and usually hierarchical [15]. Taxonomy do two things: give exact names for domain and show which things are parts of other things sometimes called parent-child relationships, sometimes called broader-narrower.

Ontologies contain all the entities in the domain and show the relationships between each other. Ontologies have more characteristic, where it has strict, formal rules about those relationships and makes meaningful and precise statements about the entities or relationships. The definition of the concepts and their relationships for a given domain differentiate between ontologies and data model, where data model represents the structure and integrity of the data elements. The importance thing is on how the domain knowledge is structured. It must get some mutual understanding to do that, it is not based on personal assumption about certain domain knowledge. Ontologies can be break into information about classes, subclasses, slots, and instances. Most ontology discussion focuses on classes, which describe concepts in the domain or subject area. Ontologies are used in artificial intelligence, the semantic web, software engineering and information architecture as a form of knowledge representation about the world or some part of it. It is a property of more general classes inherited by the more specific ones and aims to give a correct result to the user by eliminating irrelevant information [16].

Ontologies will help to: (1) share a common understanding of information; (2) reuse knowledge; (3) make assumptions about knowledge more explicit; (4) separate domain and operational knowledge; and (5) analyze domain knowledge [18]. Developing ontology is similar to defining a set of data and their structure for other programs to use.

Sharing common understanding of the structure of information among people or software agents is one of the more common goals in developing ontologies [19]. If Web sites share and publish the same underlying ontology of the terms they all use, then computer agents can extract and aggregate information from these different sites. The agents can use this aggregated information to answer user queries or as input data to other applications. Enabling reuse of domain knowledge was one of the driving forces behind recent surge in ontology research. If one group of researchers develops such ontology in detail, others can simply reuse it for their domains and integrate several existing ontologies describing portions of the large domain. Making explicit domain assumptions underlying an implementation makes it possible to change these assumptions easily if knowledge about the domain changes. In addition, explicit specifications of domain knowledge are useful for new users who must learn what terms in the domain mean. Separating the domain knowledge from the operational knowledge is another common use of ontologies. Analyzing domain knowledge is possible once a declarative specification of the terms is available. Formal analysis of terms is extremely valuable when both attempting to reuse existing ontologies and extending them [18].

CHAPTER 3

METHODOLOGY

3.0 METHODOLOGY

Ontology is aim to give a correct result to the user by eliminating any irrelevant information. Ontology development process is not like a system development process like a waterfall model or a spiral model. Ontology development process is more on the standard development process that is agreed upon some guidelines. There are seven steps that need to developing ontology, include:

- Determine Domain and Scope
- Consider Reuse
- Enumerate Terms
- Define Classes and the Class Hierarchy
- Define Properties
- Define Constraints
- Create Instances

Ontology development is an iterative process. After evaluation, if there are some mistakes, developer need to come back to previous phases and correct the mistakes. First step is determined domain and scope. There is no correct ontology of a specific domain. Ontology is an abstraction of a particular domain, and there are always viable alternatives. What is included in this abstraction should be determined by the use to which the ontology will be put and by future extensions that are already anticipated.

Some basic question to be answer during determine the scope such as "what is the domain that the ontology will cover?"; "For what we are going to use the ontology?"; "For what types of questions should the ontology provide answers? "; and "Who will use and maintain the ontology?" These answers will lead to creating a good domain and scope to make sure that it is useful. As for this project, Tourism is the domain knowledge that needs to be explicitly elaborate while Malaysia is the scope for the domain knowledge. The relationship between the terms in the domain will answer some of the basic questions.

Since ontology becoming widespread nowadays, developers do not have to start from scratch when defining ontology. Usually ontology available from a third party that can provides at least a useful starting point. By having, re-use ontology; developers can make more effective reuse of concepts across diverse applications if they share the same terminology and semantics for the most general concepts. Re-use other ontology will lead to save the effort to create new ontology from scratch. It also can make the existing ontology to interact with the tools that use other ontologies. Beside that, the system can be more powerful because it uses ontologies that have been validated using several techniques. Ontology libraries such as Protégé ontology library, DAML ontology library, and Ontolingua ontology library provide a good place for a new user to find an existing ontology. Swoogle.com also is used to query for any existing ontology. As for this project, there is an ontology that close to tourism ontology, but it is not complete yet. Furthermore, the ontology did not applicable to Malaysian Tourism because it is developed based on US culture. Even though the domain is tourism, but again the scope is different where the existing ontology is only elaborate based on US scope and not applicable to Malaysian scope.

To enumerate the terms, all the relevant terms that is expected to appear in the ontology need to write down in an unstructured list. Developers need to answer questions such as "What are the terms we need to talk about?", "What are the properties of these terms?" and "What do we want to say about the terms?" before developing the ontology. Those questions will make the assumption of the terms more explicit. Nouns form should be

the basis for class names while verbs (or verb phrases) form the basis for property names. Select the most important words to be talk about in order to enumerate the terms more precisely. For tourism, some of the important words are *hotels, destination, festivals, shopping, entertainment* and *activities*. Traditional knowledge engineering tools can be used to obtain the set of terms an initial structure for these terms. Refer figure 3.1 for full list of Malaysian Tourism class and subclass.

Next steps are defining classes and class hierarchy. Relevant terms must be organized in a taxonomic hierarchy. Opinions differ on whether it is more efficient or reliable to do this in a top-down or a bottom-up fashion. The classes need to ensure that hierarchy is indeed a taxonomy. If A is a subclass of B, then every instance of A must also be an instance of B. For example, a class of *tourism* represents all info about the tourism itself. Specific place or activities are instances of this class. A class can have subclasses that represent concepts that are more specific than the superclass. For example, class of *activities* can be divided into *relaxation, sightseeing, shopping, sports,* and *adventure*. Slots describe properties of classes and instances: *adventure* activities have *base-jumping, white water rafting, rock climbing,* and *mountain biking*. Two slots describing the *adventure activities* in this example: the slot *place* and the slot *state*. At the class level, the instances of the class *activities* will have slots describing where the specific place the activities took place and at which state.

Properties often interleaved with the previous step. The semantics of **subClassOf** demands that whenever A is a subclass of B, every property statement that holds for instances of B must also apply to instances of A. It makes sense to attach properties to the highest class in the hierarchy to which they apply. While attaching properties to classes, it makes sense to immediately provide statements about the domain and range of these properties. Whereas, filling the ontologies with such instances is a separate step. The number of instances determine by the number of classes. Some anomalies need to be checked to ensure consistency. Some of examples of common incompatible are incompatible domain and range definitions for transitive, symmetric, or inverse properties, cardinality properties, and requirements on property values can conflict with

domain and range restrictions. Since the process is an iterative process, so the evaluation consists in checking for completeness, consistence and avoiding from redundancy. After evaluation, the processes return to previous phases to correct any mistake.

For visualization stage, graphic visualization tool is used to view and browse the ontology. Graph visualization helps to browse and comprehend the structure of ontologies, analyze their network connections and observe any changes. A lightweight ontology visualization tool used caters for common ontology features and meets some of the special requirements for visualizing such network structures.

TGVizTab is used to visualize the ontology. It is an ontology visualization plug-in for Protégé based on TouchGraph. The plug-in aims to visualize and browse the ontology via interactive dynamic graphs and help users easily locate objects of interest and ease this problem by hyperlinking each graph node with its corresponding Protégé class or instance. TGVizTab is generic, dynamic (graphs created on the fly), and customizable to cater for specific ontology visualization requirements, such as handling different types of relations and edge labelling [20]. TGVizTab graphs can be saved in XML and viewed with other TouchGraph applications.

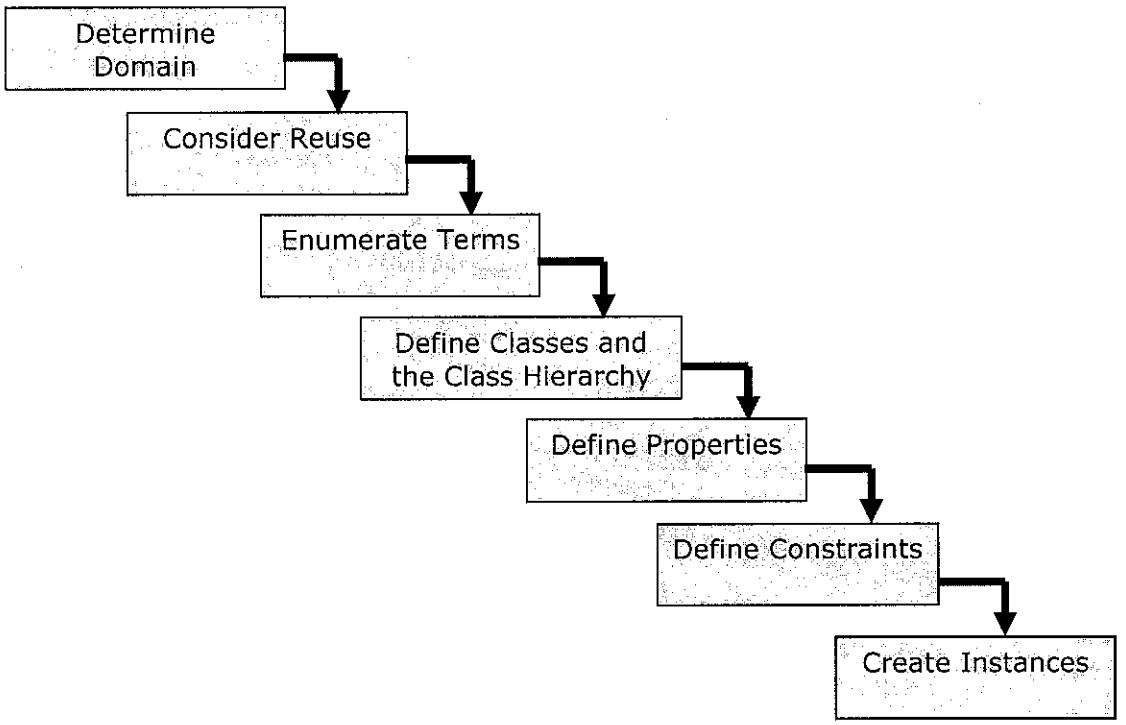


Figure 3.2: Ontology development process

3.1 Tools Required

Ontologies can be realized using ontology editor and stored in a specific format. Ontology editors help knowledge engineers build ontologies. It supports the definition of concept hierarchies, the definition attributes for concepts, and the definition of axioms and constraints. It provide graphical interfaces and conform to existing standards in Web-based software development and enable the inspecting, browsing, codifying, and modifying of ontologies, and support ontology development and maintenance tasks. There are several ontology editors available such as Ontolingua, Protégé, OntoEdit, and OILed. The one that been used in this project is Protégé 3.2 Beta. It is a free, open-source platform that provides a growing user community with a suite of tools to construct domain models and knowledge-based applications with ontologies. At its core, Protégé implements a rich set of knowledge-modelling structures and actions that support the creation, visualization, and manipulation of ontologies in various

representation formats. Protégé can be customized to provide domain-friendly support for creating knowledge models and entering data. The Protégé platform supports two main ways of modelling ontologies:

- The **Protégé-Frames** editor enables users to build and populate ontologies that are *frame-based*, in accordance with the Open Knowledge Base Connectivity protocol (OKBC). In this model, an ontology consists of a set of classes organized in a hierarchy to represent a domain's salient concepts, a set of slots associated to classes to describe their properties and relationships, and a set of instances of those classes - individual exemplars of the concepts that hold specific values for their properties.
- The **Protégé-OWL** editor enables users to build ontologies for the *Semantic Web*, in particular in the W3C's Web Ontology Language (OWL). An OWL ontology may include descriptions of classes, properties and their instances.

CHAPTER 4

RESULT AND DISCUSSION

4.0 RESULT AND DISCUSSION

4.1 Result

Result for structured Malaysian Tourism information is being present in an organizational chart. The result is being structured from the data or information extracted from several webpage. The classes and sub-classes is being structured in hierarchy way to give a clear picture or a clear meaning to the user who want to view the ontology. Figure 4.1 (in the appendix) shows the chart for Malaysian Tourism. Explicit data about Malaysian Tourism is collected by explore the Malaysian Tourism website as a main source and other websites to collect any additional information. Beside that, related information from other leading search engine such as kartoo.com and clusty.com also taken into consideration. Both metasearch engines yield quite good result. Firstly, after get the correct hierarchy or the correct order for the tourism, it is rank based on most viewed by user or preamble information. From the hierarchy, the terms were enumerated to make sure that important and correct terms were used. After manage to collect information on 14 states in Malaysia, each state will have its own activities and destination that will attract tourist interest. Instead of display all the activities or places in each state, it is characterize under a destination class. The result for Malaysian Tourism Ontology has been revised many times, to ensure that the information is accurate.

Visualization could help in variety of tasks and there is an increasing need for tools to graphically and interactively visualize such modelling structures to enhance the clarification, verification, and analysis [20]. Visualization techniques have been used by some web search tools, such as Kartoo (www.kartoo.com), and Renardus (www.renardus.org). If users can see how their chosen search terms map on the overall knowledge map, they can make up their mind on several things, such as (1) whether the general area of knowledge that the search terms has mapped onto reflects their area of interest, (2) whether or not to probe further on to the mapped knowledge domain to select the specific area of interest, (3) whether or not to select an alternative search term to map onto the right area of interest onto the knowledge map, and so on [21]. This, in turn will allow the users to retrieve better results, by selecting the most appropriate search terms, and by selecting a specific domain. Thus, such a system will allow the users to select the most appropriate search terms, and thereby retrieve better results.

Figures 4.2 to 4.4 show the knowledge map. The left side shows the hierarchy while the right side of the screen provides a visual display of the various nodes and their links. It may be noted that the demonstration is not meant to show a complete knowledge map. However, the objective of this project paper, and the demonstration that follows, is to show how to visually display an ontology and a knowledge map, which in turn can help the users formulate and expand queries in an online search session. Figure 4.1 shows a demonstration of the main classes and their subclasses. User can use the hierarchy of classes (*:Thing*) and subclasses that appears at the left side of the screen to display more subclasses, or can double click on any node in the visual map. The map will change and display the links from the chosen node. For example a double-click on the node *'Malaysia'* from the *:Thing* class, will display a visual map shown in Figure 4.2. It will display all the node for *'Malaysia'* subclass. A double click on *'Religion'* from Figure 4.2 will display a map shown in Figure 4.3 where list of instances for religion in Malaysia will pop up. Each instances would display in red, while classes in black font. The configuration for the setting can be change based on user preferences.

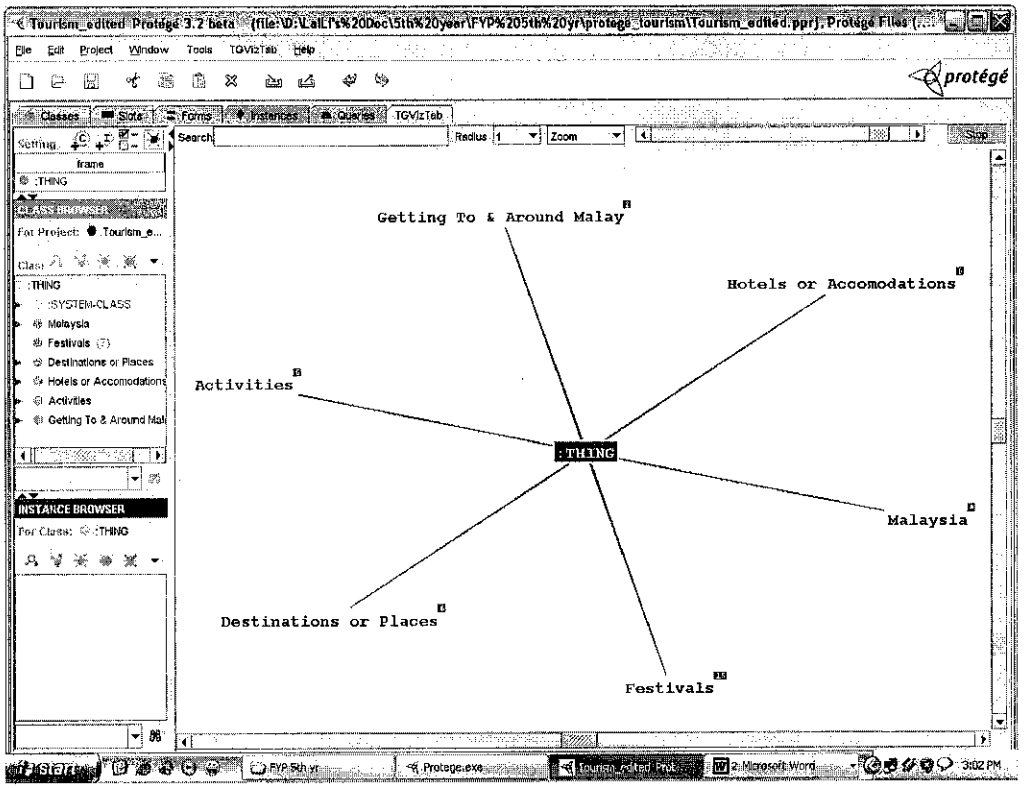


Figure 4.2: List of subclass for *:Thing*

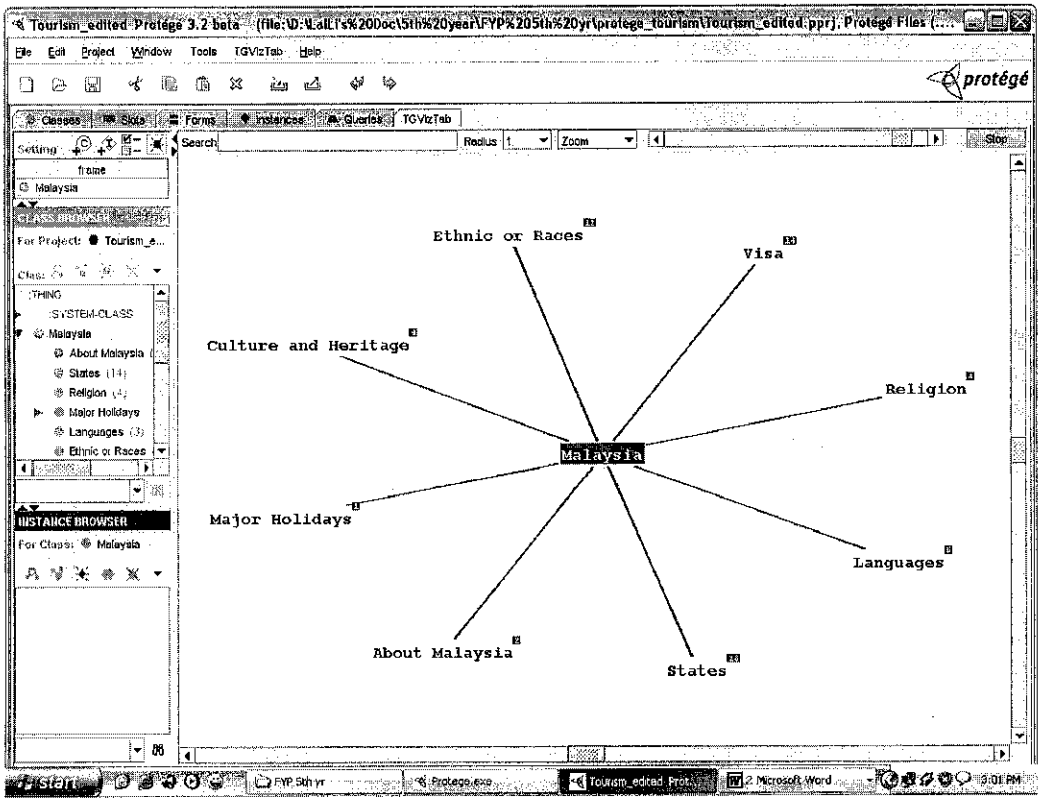


Figure 4.3: *Malaysia's* subclass

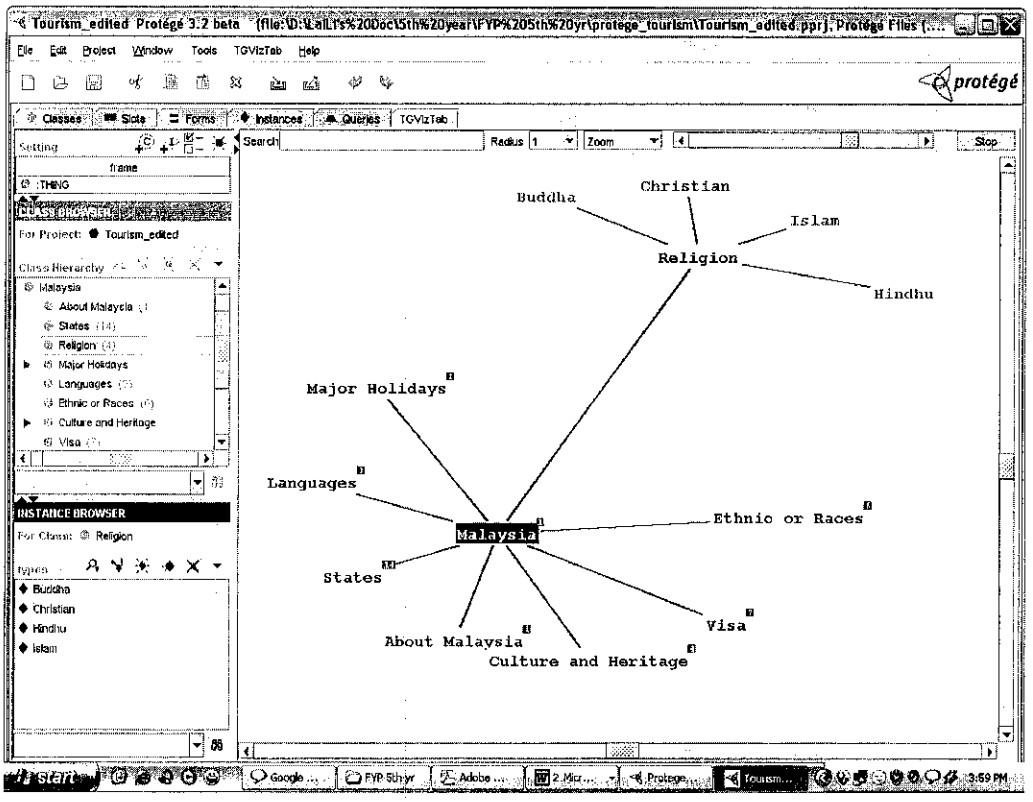


Figure 4.4: Instances for *Religion* class.

4.2 Discussion

Ontology development is actually a knowledge management process and starts with knowledge creation. It is following the initial statement of goals, scope, domain and type of learners for ontology development, processes for knowledge creation, namely externalization (conversion of tacit knowledge to explicit knowledge), internalization (explicit to tacit) and intermediation (explicit to explicit), are integrated. Externalization process requires a conscious effort by the domain expert to transform tacit knowledge into explicit which is difficult to extract or articulate. The intermediation process involves conversion of heterogeneous knowledge items and sources from outside the web based course are collated, certified, and imported. Next is knowledge extraction. This involves capture of metadata and summary content of various knowledge items. This also includes capturing alternative terminologies in a given domain, using annotation techniques.

The standard approach to classification of knowledge for ontology development is to divide the domain area into classes of objects with common properties. Then, identify the special classes, which would have their own properties apart from inheriting the general properties. This is followed by populating concepts, relations and attributes for each knowledge item in the knowledge base. The information collected is then converted into usable ontology by using formal representation languages such as Resource Description Framework (RDF), which provides the facilities for defining vocabulary, structure, and constraints for developing ontology. The ontology can be used to provide a navigational view and integrated information view of the knowledge item. It also enables them to put the knowledge in the right perspective, this is known as knowledge retrieval. As for knowledge sharing and use, the accumulated knowledge can be used by the next set of learners. Thus, enables three-way knowledge sharing: between learners and domain experts, between learners of the same generation, and between successive generations of learners [22].

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

With the explosion of the Internet, grew the need to share and reuse networked knowledge. Ontologies aim to fulfill that need by facilitating the goals of *sharing*, *reuse,* and *Interoperability*. They achieve this by moving the focus of systems design away from technology, and towards a solution that works at the levels of both technology and knowledge. This is an important step, and is necessary to make the best use of the electronic knowledge available to us. Effective and efficient work with ontologies requires support from advanced tools. It must be highly intuitive to the user.

The Malaysian Tourism information is structured and presented in a hierarchy way. The extracted data from several website and metasearch engine is being categorize based on the relationship among the terms and its domain. The ontology is being implement in a machine-readable representation knowledge language by develop it using Protégé. The domain now can be shared and re-use by other developers and fulfill the requirement or the attributes for developing the ontology.

The Ontology can create a model of rich knowledge relationships, which enable much more intelligent, relevant search results. Open source Ontologies unlock the ultimate power of the World Wide Web; enabling anyone anywhere to benefit from someone

else's expert knowledge of a particular domain. It enhances the value of knowledge management.

The use of visualization is as a cognitive aid for managing ontologies and knowledge representations. It could help in understanding not only which concepts but also why such changes occurred. By browsing the ontology using this technique, user can get a clear picture on the domain knowledge and the relationship among the terms. Visualization is becoming an important part in the development life cycle of ontology.

5.2 Recommendations

One of the future enhancements that can be applied to this ontology is by creating a search function that is embedded in the protégé source code. The search function will eliminate any irrelevant information and yields an accurate result to the user. This function is aim to give a correct result to the user by eliminating any irrelevant information and focus their attention on key information that is relevant. The function need to be integrated with ontology and test it to make sure that the ontology is working and can give a correct result.

The next step will be to interface this ontology with web search engines and digital libraries thereby allowing the users to use the visual knowledge map to formulate and refine queries and conduct a web search. Of course, the knowledge map displayed here is very simple; more work is needed to build a complex ontology structure with appropriate links among the various concepts. End-users should be involved to conduct search for electronic information using the visual knowledge map, and to comment on its usefulness.

Since ontology's application have been extending to different domain areas such as knowledge engineering, e-commerce, and knowledge management. Ontology is increasingly becoming popular due its potential to bring the web to its full potential and

make it more powerful [1]. In order to helps improve the accessibility and gives other useful resource information to support the maintenance (e.g. to find data sets, to determine whether the data set is appropriate for a certain use, etc.). Thus, metadata can be use to facilitate and improve the retrieval of information. Metadata could be used for describing ontologies for sharing, exchanging, and reusing ontologies in a most efficient way. To achieve this goal, it is necessary to agree on a standard for ontology metadata that is a common set of terms and definitions describing ontologies, so called metadata vocabulary. Then, implementing such a vocabulary will increase the value of ontologies by facilitating ontology sharing and reusing through time and space. If ontologies are described using ontology metadata standards, an appropriate technology infrastructure is required.

REFERENCES

1. Berners-Lee, T. 1999. *Weaving the Web*, San Francisco; Harper.
2. Guarino, N., "Formal Ontology in Information Systems". *Proceedings of FOIS'98, Trenton, Italy,* 6-8 June 1998. Amsterdam, IOS Press, pp. 3-15.
3. Margaret-Anne, S., Robert, L., Nei, E., and David, P., "Visualization and Protégé", University of Victoria, Victoria, BC, Canada
4. Berners-Lee, T., Hendler, J., and Lassila, O. (May 2001). "The Semantic Web", *Scientific American,* 284(5), 34-43.
5. Fensel, F., Van, H., Michel, K., Hans, A., "On-To-Knowledge: Ontology-based Tools for Knowledge Management Dieter", Free University Amsterdam VUA, Division of Mathematics and Informatics De Boelelaan 1081a, NL-1081 HV Amsterdam, The Netherlands
6. Heylighen, F., Apr 17, 2000 "What is a world view", Available online at : http://pespmc1.vub.ac.be/WORLVIEW.html
7. "Ontology Engineering & Ontology Acquisition" , University of Southampton
8. Deborah, L., McGuiness. 2002 "Ontologies Come of Age". *Spinning the Semantic Web: Bringing the World Wide Web to Its Full Potentia*l. MIT Press
9. Reamy, T. 2002. "Imparting knowledge through storytelling, Part 2." *KMWorld 11(7).* Available online at: http://www.kmworld.com/publications/magazine/index.cfm?action=readarticle&Article_ID=1328&Publication_ID=74
10. Delphi Group. 2003. "Maximizing Organizational 'Know How' in Government Entities." *Snapshot. Boston: Delphi Group*
11. Venkata, R., .2002. "Taxonomies, Categorization, and Organizational Agility." *KM World supplement.* Available online at: http://www.kmworld.com/publications/whitepapers/KM2/venkata.pdf
12. Inxight. 2003. "Inxight SmartDiscovery: The Complete Solution for Enterprise Information Discovery." *Sunnyvale, CA.* Available online at: http://www.inxight.com/products/smartdiscovery/

13. Database, From Wikipedia, the free encyclopedia. Available online at : http://en.wikipedia.org/wiki/Database
14. Metadata, From Wikipedia, the free encyclopedia. Available online at : http://en.wikipedia.org/wiki/Metadata
15. Are the terms ontology, taxonomy, and folksonomy interchangeable? Available online at: Ask MetaFilter
16. Ontology, From Wikipedia, the free encyclopedia. Available online at : http://en.wikipedia.org/wiki/Ontology
17. Sowa, J. F., 2004. "Ontology, Metadata, and Semiotics." Available at: http://users.bestweb.net/~sowa/peirce/ontometa.htm
18. Noy, N. F., and McGuiness. 2000. "Ontology Development 101: A Guide to Creating Your First Ontology". *Stanford Knowledge Systems Laboratory Technical Report KSL-01-05 and Stanford Medical Informatics Technical Report SMI-2001-0880,* Available online at: http://www.ksl.stanford.edu/people/dlm/papers/ontology-tutorial-noy-mcguinness-abstract.html
19. Musen, M.A. 1992. "Dimensions of knowledge sharing and reuse." *Computers and Biomedical Research* **25**: 435-467.
20. Alani, H., "TGVizTab: An Ontology Visualization Extension for Protégé." in *Knowledge Capture 03 - Workshop on Visualizing Information in Knowledge Engineering*, (Sanibel Island, FL, 2003), ACM, 2-7.
21. Sudatta, C., and G.G. Chowdhury., "Using DDC to create a visual knowledge map as an aid to online information retrieval". Department of Computer and Information Sciences University of Strathclyde, Glasgow G1 1XH
22. Sridharan, B., Tretiakov A. and Kinshuk. 2004. "Application of Ontology to knowledge Management in Web based Learning". In *Proceedings of the 4th IEEE International Conference on Advanced learning Technologies 200.* Los Alamitos, CA: IEEE Computer Society (ISBN 0-7695-2181-9), 663- 665
23. Jens, H., Ra'ul, York, S., Carmen S., F., Peter H., "Ontology Metadata Vocabulary and Applications" *Ontology Engineering Group*, University of Karlsruhe, Germany.

APPENDICES

APPENDIX A

- Malaysia
    - Background
    - Images or gallery
    - Country & Capital
    - Geographical location
    - Area
    - Population
    - States
    - People
    - Languages
    - Religion
    - Government
    - Major holidays
        - Festivals
    - Climate
    - Economic profile
    - Passport or visa

    - Culture and heritage
        - Architecture
            - Traditional
            - Colonial
            - Modern
        - Traditional games and past times
        - Handicraft
            - Textile
            - Jewellery & costume accessories
            - Earthenware
            - Woodcrafts
            - Metal crafts
            - Hand-woven crafts
            - Pastime crafts
        - Traditional attire
            - Malay
            - Chinese
            - Indian
            - Baba nyonya
            - Portugese – Eurasian
            - Sarawak
            - Sabah
            - Orang asli
        - Traditional music

- Dance
- Music
- Instrument

- Destination or places
  - Island & beaches
  - Shopping centre
  - Culture or heritage
  - Fun and entertainment
  - Sports
  - Nature
  - Hills

- Hotels or accommodations
- Activities
- Festival
- Getting To & Around Malaysia

Figure 3.1: List of the tourism ontology

APPENDIX B

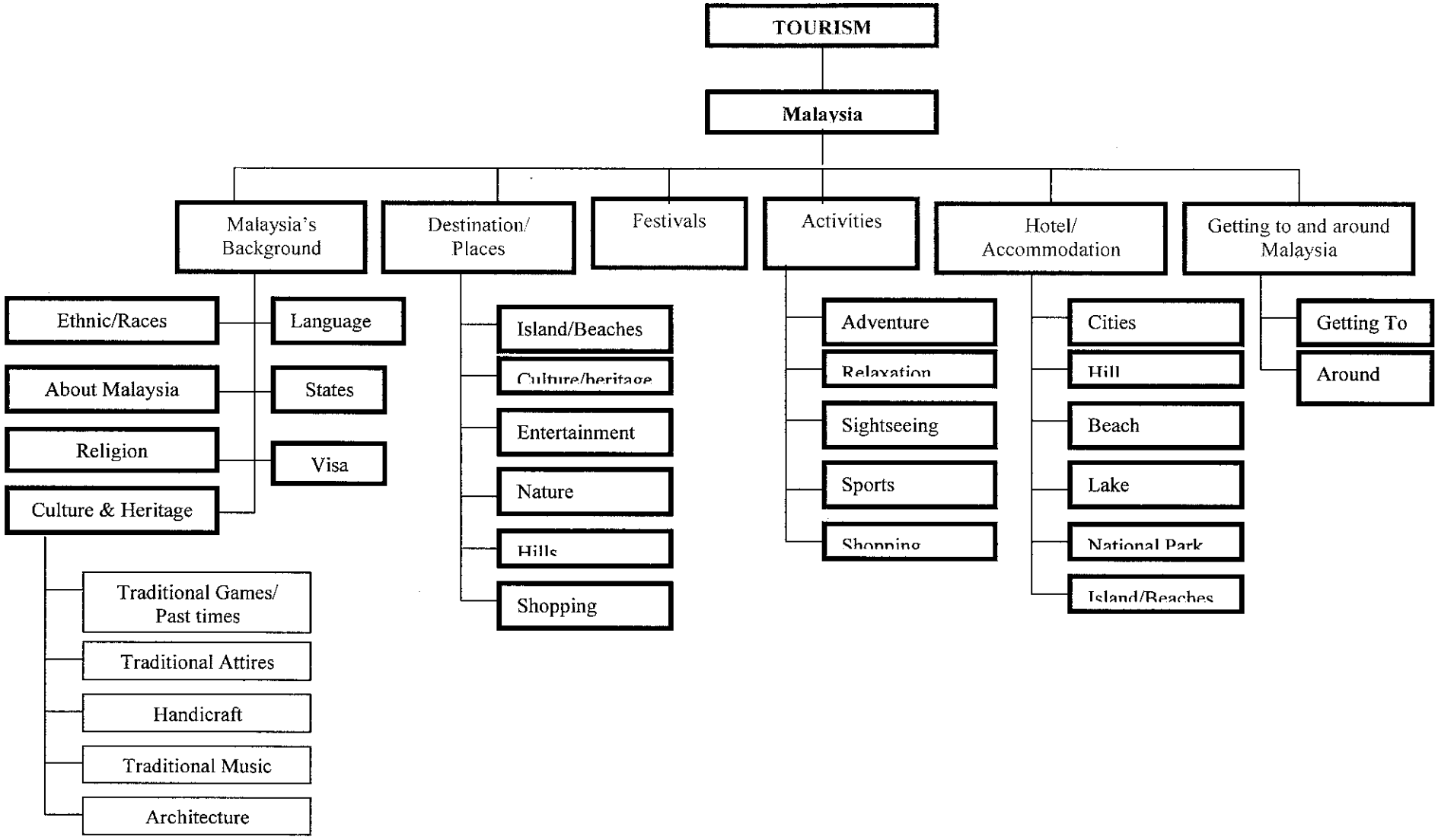


Figure 4.1: Tourism ontology chart.