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Ontology-Based Approach For Laptop Semantic Knowledge Representation

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Abstract

The rapid development of technology requires everyone to adapt. It is the same as the demands of work and school so that everyone should be more able to handle this problem. It is inevitable that the use of laptops today is not something that is a step. Almost all age groups use laptops to do school work, complete office work, or as a medium of entertainment. With so many types of laptops, some people are confused about choosing a laptop. The use of ontology as an information representation technique is a solution to this problem. Ontology can present information or knowledge sources semantically and organize various information resources in a systematic and structured manner. In the development of this ontology will be made using the methontology method. Methontology is one of the ontology model development methodologies which has advantages related to a detailed description of each activity. In addition, methontology also has other advantages, namely the development of ontology that are now made usable for further system development. Therefore, this study is proposed to build an ontology model that represents knowledge about laptops. This laptop ontology has displayed the information that is needed.

Keywords: *Laptop, Ontology, Semantic web, Methontology, SPARQL*

1. Introduction

Along with advances in technology and information that are increasingly sophisticated, human life has finally developed and reached a level called modern. Technology is developed by humans based on science and common sense so that more innovation becomes something that is easier for someone to use in achieving his goals. The freedom to access the internet through laptops and other hardware is one of the clear evidence around us about the inevitable technological developments. Since the use of computers has become a familiar thing, many people operate laptops in their daily life. This greatly supports the development of computerization as laptops are versatile and practical tools that support many people in carrying out their duties, both in terms of education and profitable businesses or as a means of entertainment [1]. With the nature that can be carried anywhere, laptops are in great demand. In addition, the computing functions offered are like computers in general, laptops become mandatory items when traveling if they have high mobility and many tasks must be completed either from offices, campuses, or schools [1]. Therefore, laptops are no longer a step and have become a necessity from children to adults.

Based on data obtained from the statista.com page, according to Credit Suisse's research, laptop shipments around the world had previously decreased in 2015 but then gradually increased in the last five years, namely 2016; 156.8 million units, 2017; 162.6 million units, 2018; 162.3 million units, 2019; 166 million units, and 2020 198.3 million units. As time goes by and more and more innovations are developed, the functions of laptops are now increasingly diverse. Not only

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as a working device, laptops are also used as friends to play online games, communication tools and surfing tools in cyberspace. With many enthusiasts with various motivations, folding computers were then designed in such a way with increasingly sophisticated and varied specifications and features [2]. The next problem comes when web resources in the form of laptop product information are stored in an unstructured and scattered manner which can make data interoperability difficult. A large amount of information about laptops is available on the World Wide Web (WWW), where when searched by major search engines will provide a lot of unwanted information, requires relevant information to be filtered, consumes a lot of effort and time. So in this case, an ontology approach is needed that will help determine how to present the necessary design decisions based on objective criteria in accordance with the desired results [3]. In this study, the authors propose web semantic ontology modeling in the laptop domain. The method applied in this research is methontology method. This study is useful to understand the implementation of semantic ontology in building ontology models that represent the domain of knowledge about laptops. This research is expected to be able to build a laptop ontology model as a recommendation that has good design quality by utilizing the methontology method. Ontology is proven to be an effective knowledge representation and information retrieval technique, which is a core concept in semantic web applications. Knowledge representation with ontology helps in effective information retrieval compared to other representation technologies.

1.1 Laptop

Laptop is a mobile computer device. Portable computers and / or folding computers that are relatively small and light in size so that we can take them anywhere we want. A laptop consists of a CPU, Monitor, Keyboard, Trackpad and battery powered battery which can be recharged by mains power so that the laptop is intended to operate without being plugged into a power outlet. Laptops are significantly slower than desktop computers, but advances in manufacturing have made laptops and desktop computers equally performing. The laptop parts we use consist of a variety of hardware arranged. These parts have each function that helps the performance of a laptop. Well-known laptop manufacturers such as Asus, Dell, Lenovo, Acer, Apple compete with each other in the laptop market by issuing laptops with their best components.

1.2 Semantic Web

Semantic web is an approach specially developed in web technology. The technology of Web Semantics and Web Semantics provides us with a new approach to managing information. That process is the basic principles of creation and using of semantic metadata. As additional information, metadata can exist at two levels. The first level is metadata can describe a document like a web page, or a part of a document such as a paragraph. Second level is describe the entity in the document, for example, a person or company [4]. However, the matter is metadata is semantics, which provides knowledge about the content of the document (for example, its subject, or relationships to other documents) or about the entities in the document.

1.3 Ontology

Ontology is a way to represent knowledge from a set of concepts in an information domain and the relationship between these concepts, so that ontology can be used to present information semantically and to organize and map a collection of information resources in a systematic, and structured manner. This is a very useful regarding data interoperability because it can be done in a more effective and efficient manner [5]. There are several benefits for using ontologizes, such as being able to explain a knowledge domain explicitly, namely providing a hierarchical structure of concepts to describe a domain, and how they are related. Can share understanding of structured information and reuse the knowledge domain. Suppose we want to build a broad ontology that can develop existing ontologizes and integrate with some other ontologizes that are relevant to the ontology to be built [6]. One of the main features of ontologizes is that by having important relationships between concepts built into them, they allow automatic reasoning about data. Such reasons are easy to implement in semantic graph databases which use ontology as their semantic schema.

1.4 SPARQL

SPARQL is a query language for RDF. RDF Graph is a triple formed from Subject, Predicate and Object, RDF can be defined in RDF Concept and Concept Syntax Abstract. For Instances can be obtained directly from RDF documents, can be inferred from the RDF triple. RDF expressions can be saved in other formats such as XML and Relational Databases. SPARQL is a query language to get information from RDF Graph. Which provides facilities such as extracting information in the form of URI, Blank Node and Literal, extracting RDF Subgraph and building a new RDF Graph based on query graph [7].

2. Research Methods

The method used in the construction of the ontology model in this study is the method of methontology. Methontology is one of the ontology model development methodologies, where it has the advantage of describing each activity that must be carried out in detail. In addition, methontology also has the ability, namely, the ontology that is built can be reconstructed for further system development.

In general, the methodology provides a set of guidelines on how to carry out the activities identified in the ontology development process, what types of techniques are most appropriate in each activity, and what products are produced. Therefore, one of the methodologies in the development of ontology is a methodology that offers a detailed conceptualization activity implementation at each stage [8].

2.1 Specification

The purpose of the specification phase is to produce an informal, semi-formal, or formal ontology specification document written in natural language, each using an intermediate set of representations or using competency questions.

2.2 Knowledge Acquisition

Knowledge acquisition is an independent activity in the ontology development process. Most of the acquisitions were carried out in conjunction with the requirements of the specification phase, and diminished as the ontology development process moved forward.

2.3 Conceptualization

This section will compile domain knowledge in a conceptual model, that describes the problem and its solution concerning domain vocabulary identified in the ontology specification activity [9]. The first thing to do is build a complete glossary. Thus, the glossary identifies and collects all useful and potentially usable domain knowledge and their meanings.

2.4 Integration

In this stage, consider reusing definitions that are already built into the ontology. In considering the reuse of definitions already built into the ontology, the authors examined the methodology to select those that better fit the concept. Its purpose is to ensure that new and reused sets of definitions are based on the same basic set of terms.

2.5 Implementation

This stage is the implementation process of the ontology design.

2.6 Evaluation

Evaluation means carrying out a technical assessment of the ontology, software environment, and documentation in connection with term of reference during each phase and between phases of their life cycle. Evaluation summarizes the terms Verification and Validation. Verification refers to technical processes that ensure the correctness of the ontology, associated software environment, and documentation in connection with the terms of reference during each phase and between phases of their life cycle. Meanwhile, validation is to guarantee the ontology, software and documents are in accordance with the system should be.

2.7 Documentation

There are no agreed guidelines on how to document ontology. In most cases, the only documentation available is in ontology codes, natural language texts attached to formal definitions, and papers published in conferences and journals that organize important questions of built-in ontologiy and ontograph.

3. Result And Discussion

3.1 Specification

At this stage it will produce a specification of informal, semi-formal, and formal ontology documents written in natural language, using a set of intermediate representations. The following is a description of the ontology of motorcycles.

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a. Domain: Laptop
b. Date: Sept 20, 2020
c. Conceptualized by: Samson Cornelius Gele Yowe
d. Implemented by: Samson Cornelius Gele Yowe
e. Objectives: To build ontology models to facilitate classification or laptop
f. Level of Formality: Semi-formal.
g. Scope: laptop
h. Knowledge Resource: Internet

3.2 Knowledge Acquisition

Knowledge acquisition is an independent activity in the ontology development process. At this stage, most of the knowledge acquisition is related to the specification stage. In the knowledge acquisition stage, laptop ontology uses the following techniques.

a. Informal text analysis, to learn key concepts.
b. Formal text analysis. Identify the structures to be detected (definitions, affirmations, etc.) and the types of knowledge each contributes (concepts, attributes, values and relationships).

In this study, using laptop data with the highest interested brands according to the International Data Corporation (IDC), namely HP, Lenovo, Dell, Apple, Asus, and Acer. The data used in this study was obtained from reliable internet sources.

3.3 Conceptualization

This stage aims to organize the knowledge that has been obtained during the data acquisition process. The conceptual model that has been created will be converted into a formal model which is implemented into the ontology implementation language.The knowledge domain contained in the conceptual model describes problems and solutions regarding the vocabulary found at the ontology specification stage. This stage will build a glossary that includes concepts, examples, verbs, and properties. Therefore, the glossary collects all useful and potentially usable domain knowledge and is then implemented in the form of classes and sub-classes that look like in Figure 1.

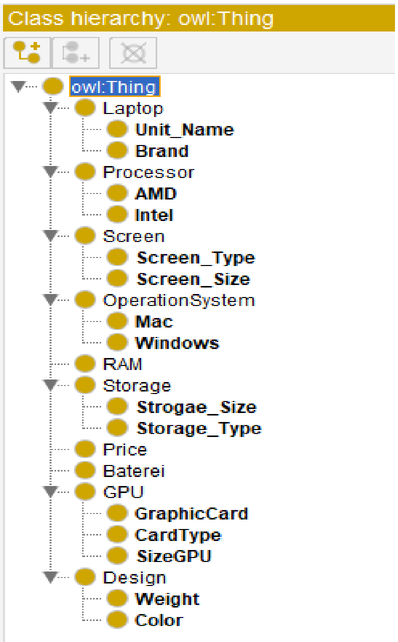

Figure 1 Class of Laptop Ontology

3.4 Integration

At this stage we will consider the reuse of definitions that have been built into the ontology. In considering the reuse of definitions already built into the ontology, the authors examined the methodology to select those that better fit the concept. Its purpose is to ensure that new and reused sets of definitions are based on the same basic set of terms. Then, the author finds out which ontology library provides definitions of semantic terms and their implementation is coherent with the terms identified in the conceptualization.

3.5 Implementation

At this stage, the authors use the Protégé 5.5.0 software. From the class that has been created in Figure 1, it will form object properties in Figure 2, property data in Figure 3 and individuals and their relationships in Figure 4. In Figure 2 it can be seen that the domain "Unit_Name" is the subject, object properties "HasBrand" act as predicate, and range "Brand" as object. Object properties act as a predicate that connects existing concepts or classes.

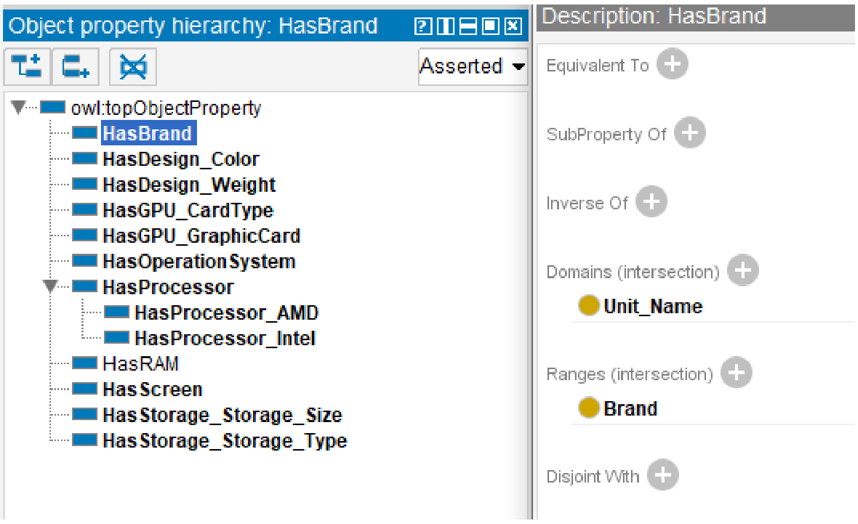

Figure 2 Object Property of Laptop Ontology

Next in Figure 3, data properties describe the attributes that the class or instance has and describe the relationship between concepts or individuals. For example, data properties "HasPrice" as price data in the domain "Price" which is of type int.

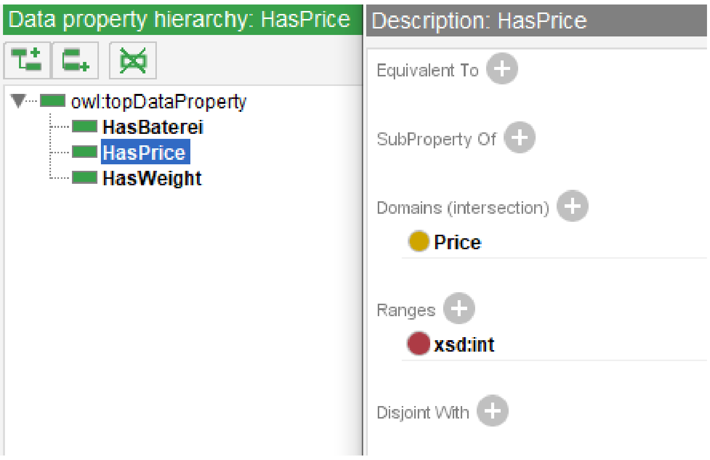

Figure 3 Data Property of Laptop Ontology

Furthermore, in Figure 4, there are counted as many individuals as collected from the data sample at pricebook.co.id. It can be seen that in the process of making individuals, there are individuals who are connected to each other with the linkage being object properties, so that, some individuals have the same attributes. In addition, individuals who are filled with data properties may be different from other individuals

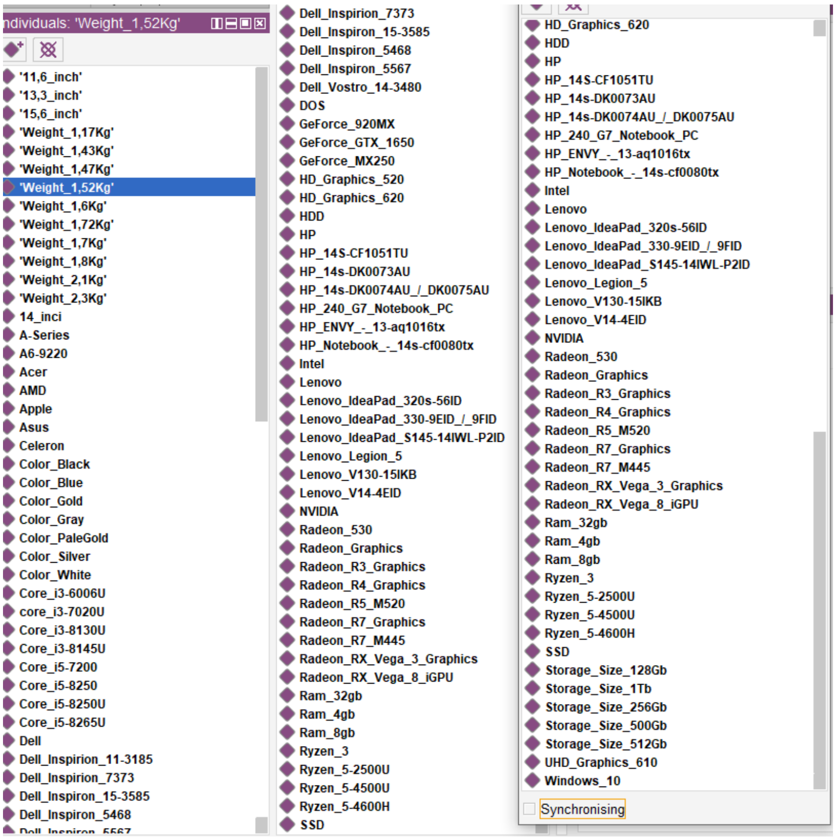

Figure 4 Individuals of Laptop Ontology

3.6 Evaluation

In the evaluation stage, it is carried out using SPARQL Query on protocol 5.5.0 which will produce a subject that is searched for and results from aligning the subject and object. In this evaluation stage, a search is carried out for a laptop that has 8GB of RAM. So we execute a query with the command to find "Unit_Name" as the subject with the Ram_8gb object and relate it to the object property which is "HasRAM". The results obtained after executing the query are that there are 14 laptops shown in Figure 5.

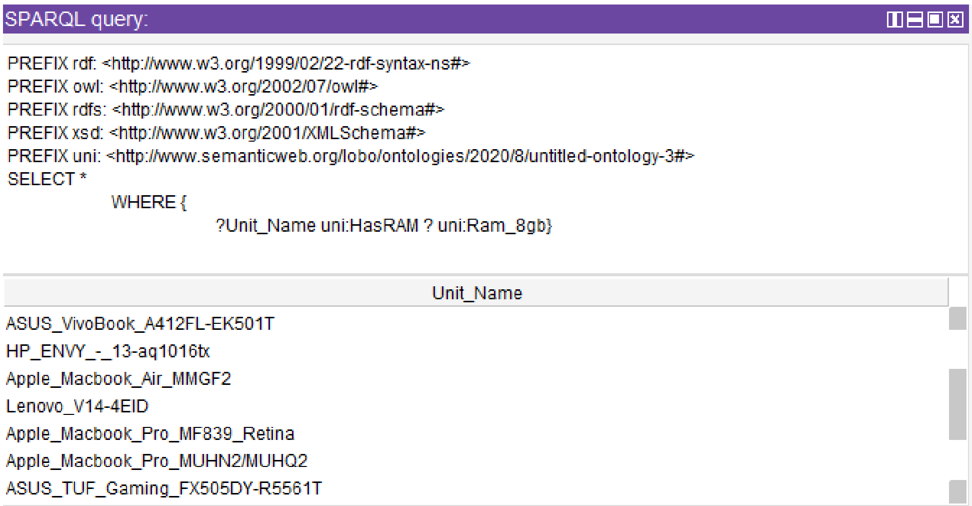

Figure 5 SPARQL Query 1 Result

In Figure 6, the authors tested by adding the attributes from the previous query (Figure 5), namely the SSD storage type. The results obtained from this execution are 11 laptops with specifications having 8 GB RAM and SSD type storage.

SPARQL query:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX uni: <http://www.semanticweb.org/lobo/ontologies/2020/8/untitled-ontology-3#>
SELECT *
WHERE {
        ?Unit_Name uni:HasRAM ? uni:Ram_8gb.
        ?Unit_Name uni:HasStorage_Storage_Type ? uni:SSD
    }
```

Unit_Name
Apple_MacBook_Pro_MF840_Retina
ASUS_VivoBook_A412FL-EK501T
HP_ENVY_-_13-aq1016tx
Apple_Macbook_Air_MMGF2
Lenovo_V14-4EID
Apple_Macbook_Pro_MF839_Retina
Apple_Macbook_Pro_MUHN2/MUHQ2
ASUS_TUF_Gaming_FX505DY-R5561T
Acer_Nitro_5_AN515-52-51T2
Apple_Macbook_Air_MQD32
Dell_Inspirion_7373

Figure 6 SPARQL Query 2 Result

In Figure 7, the authors tested by adding the attributes from the previous query (Figure 6), namely the NVIDIA graphic card. The results obtained from this execution are 3 laptops with specifications having 8 GB RAM, SSD type storage, and NVIDIA graphic card.

SPARQL query:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX uni: <http://www.semanticweb.org/lobo/ontologies/2020/8/untitled-ontology-3#>
SELECT ?Unit_Name
        WHERE {
                ?Unit_Name uni:HasRAM ? uni:Ram_8gb.
                ?Unit_Name uni:HasStorage_Storage_Type ? uni:SSD.
                ?Unit_Name uni:HasGPU_GraphicCard ? uni:NVIDIA
}
```

Unit_Name
ASUS_VivoBook_A412FL-EK501T
HP_ENVY_-_13-aq1016tx
Acer_Nitro_5_AN515-52-51T2

Figure 7 SPARQL Query 3 Result

3.7 Documentation

The results of documentation of the development of this laptop ontology are in the form of writing contained in this journal. The following is the ontology of this laptop which consists of 10 classes, 11 sub classes, 13 object properties, 3 data properties and 140 individuals.

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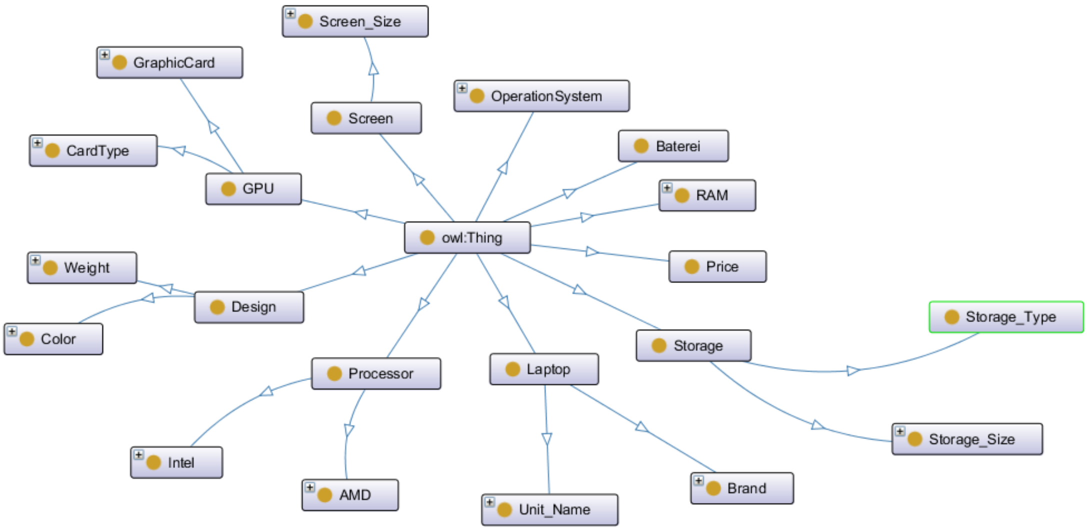

Figure 8 Ontograph of Laptop Ontology

4. Conclusion

Laptop ontology aims to collect data and facilitate knowledge management about laptops. This study uses the methontology method, which is an ontology development method that has advantages related to the description of each activity that must be carried out in detail. In this study, the ontology that is built can help users search for laptops according to the criteria and needs needed.

The application of ontology in this study can provide good information according to user requests and can represent knowledge from a set of concepts in the knowledge domain, in this case the laptop and its relationship between these concepts. Thus this laptop ontology has displayed information in accordance with what is needed.Given that the ontology can also be developed from existing ontology, so that it can be integrated with the data of several other relevant ontology into an ontology that will develop. In addition, for the future this laptop ontology can be implemented into a semantic web-based system.

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