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Ontology Development for Motorcycle Semantic Knowledge Representation

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Abstract

Transportation is currently a basic necessity in supporting daily life, starting from supporting economic activities and various other things. One of the most commonly used means of transportation is a motorcycle because it is very practical to use. However, the development of motorcycles is currently very fast, confusing the community in choosing a motorcycle that suits their needs. The solution used to overcome this problem can be overcome by using the concept of semantic ontology. The method of building the ontology model used is METHONTOLOGY. This method is one of the methods of building an ontology model that can reuse the built ontology for further system development. The motorcycle ontology development model generates 16 classes, 13 object properties, 11 data properties, and 69 individuals. The ontology evaluation process by performing SPARQL queries also provides appropriate results.

Keywords: *Motorcycle, Ontology, Semantic Web, Methontology, SPARQL query.*

I. INTRODUCTION

The role of transportation is currently an important necessity to support daily life and support economic activities such as running a business. Motorcycles are a means of transportation that is widely used in Indonesia because they are very practical to use, especially in high-traffic areas. In addition, motorcycles are an efficient means of transportation in the use of fuel and maintenance costs. Seeing the level of motorcycle use in Indonesia, the motorcycle industry is developing from year to year. From the data taken from the website of the *Asosiasi Industri Sepeda Motor Indonesia*[1] (AISI), it can be seen from the data on the domestic and export distribution of motorcycles which have often increased from year to year, it shows that the domestic and export distribution of motorcycles in 2019 were 6,487,460 and 810,433, respectively.

The large number of motorcycles created by motorcycle companies has caused problems for motorcycle buyers, namely confusion in choosing the type of motorcycle that suits their needs. So it takes an effort to assist information on motorcycles systematically so that buyers find it easier to get information to make decisions. The use of the semantic ontology concept as the backbone of the system is an alternative solution that will be used by the author. Ontology is an information representation technique that can express information explicitly and semantically in a structured and semi-structured manner.

The method of building the ontology model used is METHONTOLOGY. Methontology is a method that can be used to develop an ontology model. This method has the advantage of describing each activity. The Methontology method can reuse the built ontology for further system development. Therefore, the research proposal is to build an ontology model that represents knowledge about motorcycles. And it is expected to be able to build a model ontology with good quality.

A. Motorcycle

Motorcycles are two-wheeled personal means of transportation that are driven by engines. The development of motorcycles is from traditional bicycles. The advantage of a motorcycle is that it has

[1] https://www.aisi.or.id/statistic/

relatively smaller dimensions so that it does not require much space and is relatively more efficient than other means of transportation.

B. Semantic Web

The Semantic Web is an addition to the current web, where the information provided in the semantic web is well defined and allows computers and people to work together. The semantic web includes relationships between objects, such as people, events, organizations, and places. Semantic web technology supports documents to be carried and reused. This allows the machine to process data suddenly [1].

The semantic web can be used to represent information so that it can be used by machines for replication, integration, and reuse. In addition, web semantics can be used to explicitly declare the existing web-based applications. For the semantic web to work, computers must have access to structured collections of information [2].

Semantic web layer-cake or semantic web architectures explain that higher-level languages use syntax. The XML syntax is used as follows:

1. Resource Description Framework (RDF).
   The Resource Description Framework (RDF) is a semantic data model used to exchange data on the Web. RDF will represent information in triple which consists of subject, predicate, and object. Use of International Resource Identifiers (IRIs) to identify resources. RDF can be used to represent various types of information such as taxonomies/trees, tabular data, logical axioms, etc.
2. RDF Schema
   It is an extension of the RDF vocabulary. For defining classes and relationships, the RDF schema provides XML vocabulary. RDF schema is also for defining properties and taxonomy creation.
3. Ontology Web Language (OWL)
   OWL is the language chosen to represent the information contained in the Semantic Web. Where objects from a domain will be represented as resources and identified by Uniform Resource Identifiers (URI).

C. Ontology

The definition of ontology that is often used is "An ontology is an explicit specification of a conceptualization". Ontology is a way to represent information explicitly by providing meaning.

The vocabulary which consists of a definition arrangement that defines a concept, relationship, and the boundaries of the scope of science is called ontology. To model an ontology you can use the Ontology Web Language (OWL) which is a derivative of RDFS [3].

D. SPARQL

SPARQL is a query language used for RDF data. SPARQL consists of the same triple as RDF, namely subjects, predicates, and objects that can be variables in SPARQL. The basis of the following SPARQL should follow SELECT followed by WHERE variables and clauses followed by an RDF chart pattern.

II. RESEARCH METHODS

In this research, Methontology method is used. Methontology method is a method of ontology development that can reuse the built ontology for further system development. This method also has the advantage that every activity is detailed. Here are some steps in the Methontology method [4, 5].

A. Specification

The specification stage has the aim of producing a formal ontology level specification document, namely informal, semi-formal, or formal written in natural language. This stage uses an intermediate set of representations or uses a number of competency questions [6].

B. Knowledge Acquisition

The knowledge acquisition stage is an independent activity in ontology development, most of these stages are carried out in conjunction with the specification stage. Experts, books, and even other ontologies can provide knowledge that can serve with interviews, brainstorming, and text analysis.

C. Conceptualization

The conceptualization stage has the goal of compiling the knowledge domain in a conceptual model that describes problems and solutions in the domain with the vocabulary identified in the ontology specification activity. The first thing to do is to write a Glossary of Terms. These terms include concept, individual, verb, and property. The Glossary of Terms identifies the entire usable domain of knowledge. When you are nearing the completion of the Glossary of Terms, classify the terms as concepts and verbs [7, 8].

D. Integration

At the integration stage, consider the reuse of definitions that have been built into the ontology to accelerate the development of the ontology.

E. Implementation

In this stage is implementing the process of the ontology design to be built.

F. Evaluation

The evaluation stage aims to assess the technical ontology, software environment, and documentation relating to the terms of reference for each stage in its life cycle. The terms in the evaluation are leverage and validation. Verification ensures the correctness of the ontology, software, and documents associated with the terms of reference for each phase. Meanwhile, validation is ensuring that the ontology, software, and documents are following the system that should be.

G. Documentation

In the documentation ontology, nothing new is agreed upon. The only documentation available is in the form of ontologies, attached natural language and papers published in the proceedings, and journals that determine the important questions of the ontology that has been built.

III. RESULT AND DISCUSSION

Following are the results and discussion of this research.

A. 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.

a. Domain: Sepeda Motor
b. Date: Sept 15, 2020
c. Conceptualized by: I Made Cantiawan Giri Kusuma
d. Implemented by: I Made Cantiawan Giri Kusuma
e. Objectives: To build ontology models to facilitate the classification or motorcycle
f. Level of Formality: Semi-formal.
g. Scope: Motorcycles Yamaha, Honda, Kawasaki, and Suzuki
h. Knowledge Resource: Internet

B. Knowledge Acquisition

In the process of developing this ontology, most of the knowledge acquisition is carried out in the processing with the specification requirements stage with the ontology development process. In the knowledge acquisition stage of Motorcycle ontology using the following techniques.

a. Discuss with the Ontology engineer to prepare an initial draft of the requirements specification document.
b. Informal text analysis, to learn key concepts.

c. 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, the authors used motorcycle data with the Yamaha, Honda, Suzuki, and Kawasaki brands. Motorcycle data collection is obtained from reliable internet sources, where the data are taken is a motorcycle of a different type. To support this research, the data search uses the Google search engine. The author initially entered the keywords "Yamaha Motor", "Honda Motor", "Kawasaki Motor" and "Suzuki Motor". Each website that is used is the Sepeda Motor Yamaha Indonesia[2] website for Yamaha Motorcycles, PT Astra Honda Motor[3] website for Honda motorcycles, Sepeda Motor Kawasaki[4] website to search for Kawasaki motorcycles, and Suzuki Motor[5] website for Suzuki motorcycles. Motorcycle data taken were 25 motorcycles from 4 brands as sample data.

C. Conceptualization

Conceptualization has the aim of compiling a knowledge domain in conceptual form as well as coaching and knowledge obtained in the knowledge acquisition process. When the conceptual model has been built, the methodology will change to change the conceptual model into a formal model that will be implemented in the ontology language.

The domain of knowledge arrangement in the conceptual model can explain problems and solutions in the vocabulary domain identified in the ontology specification activity. All it does is create a Glossary of Terms that includes concepts, examples, verbs, and properties. Glossary of Terms Identify and collect all useful and usable domains of knowledge and their meanings.

D. Integration

When considering the reuse of definitions built into the ontology, the authors choose a meta-ontology that is more in line with the concepts that have been made. The purpose of doing so is to ensure the compilation of new and used content is based on the same terms. Then, the authors found an ontology library that provides definitions of semantic terms and implementations that are coherent with the terms identified in the conceptual model.

E. Implementation

In implementing the ontology model, researchers used the Protégé 4.3 application in ontology development. Protégé is a software developed by the Stanford Center for Biomedical Informatics Research at Stanford University School of Medicine. Protégé are software tools to help develop ontologies based on a basic system of knowledge. Each ontology section is defined according to the results of each stage of the task in the Methontology method. Where the definition of the concept as a class (shown in Figure 1), the ad hoc binary relationship is defined as an object property (shown in Figure 2), the class attribute and instance attribute are defined as data property (shown in Figure 3) and instances are defined as an individual (shown in Figure 4). The conceptual design that has been done is then formalized using the Protégé 4.3 application. The ontograph of the built ontology model is shown in Figure 5.

[2] https://www.yamaha-motor.co.id/
[3] https://www.astra-honda.com/product-list/all
[4] https://www.kawasaki-motor.co.id/id-id/
[5] https://www.suzuki.co.id/motorcycle

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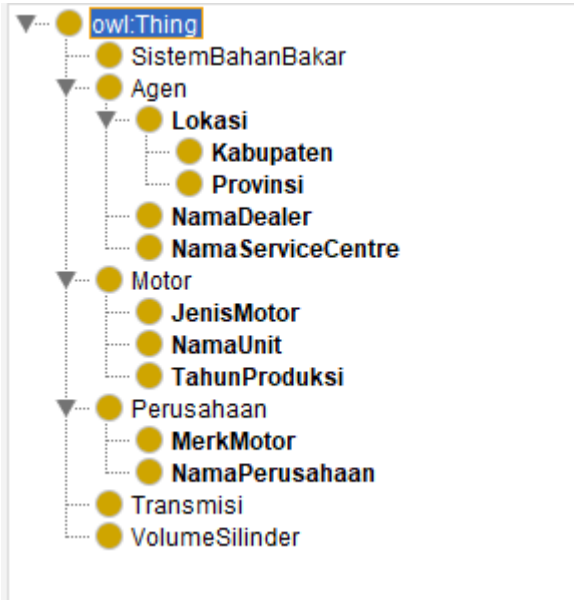

Figure 1: Class of motorcycle ontology

The classes obtained from the motorcycle ontology produced 16 classes. Each class in ontology has a relationship with an individual called a class extension.

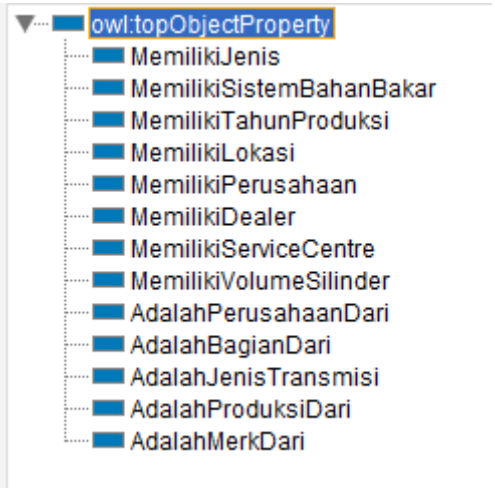

Figure 2: Object property of motorcycle ontology

The object property obtained in the motorcycle ontology yield as many as 13 object properties. Object property is a property that connects individuals to other individuals.

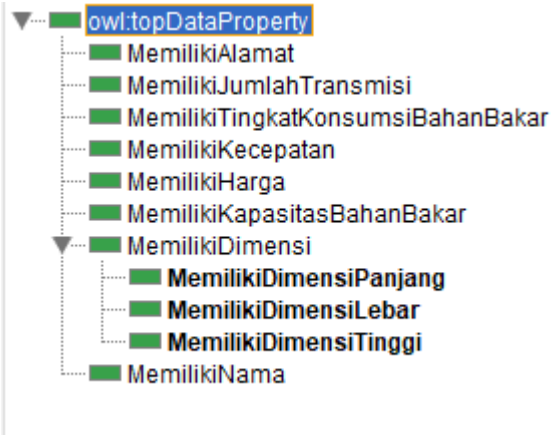

Figure 3: Data property of motorcycle ontology

The data property obtained in the motorcycle ontology yield as many as 11 data properties. The data property is properties that an individual relates to data values.

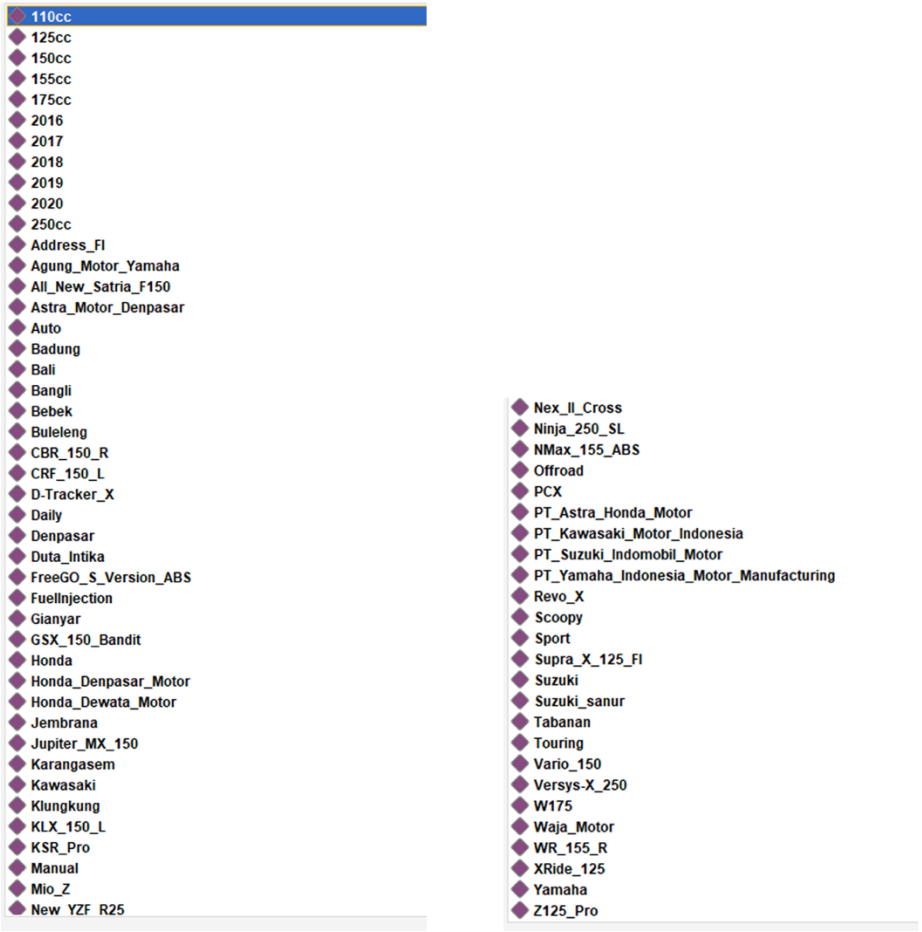

Figure 4: Individuals from motorcycle ontology

There were 69 individuals used in the motorcycle ontology. The individual in the extended class is called an instance.

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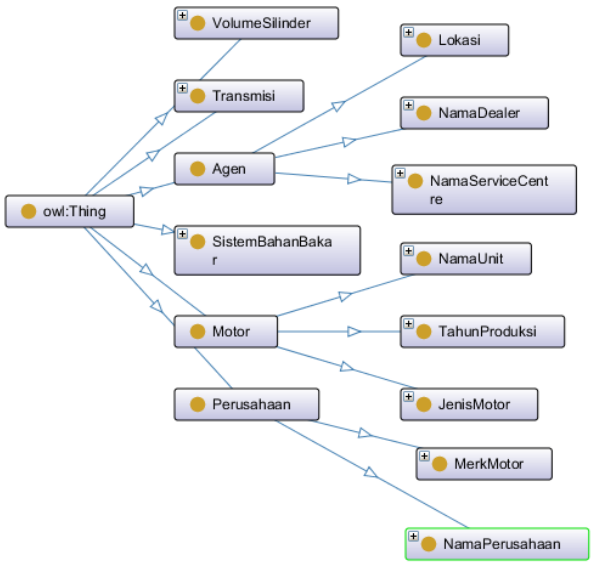

Figure 5: Ontograph of motorcycle ontology

F. Evaluation

At this stage, the authors conducted an evaluation process on the ontology that had been built. Evaluation is done by performing SPARQL queries on the Protégé 4.3 application and answering questions. Where we create a new PREFIX called project with an IRI ontology address that matches the address in the Protégé 4.3 application. Here are the results of the SPARQL query performed:

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 project: <http://www.semanticweb.org/girikusuma/OntologiSepedaMotor#>
SELECT *
        WHERE { ?NamaUnit project:AdalahMerkDari project:Yamaha }
```

```
New_YZF_R25
Mio_Z
WR_155_R
NMax_155_ABS
FreeGO_S_Version_ABS
XRide_125
Jupiter_MX_150
```

Figure 6: SPARQL query results

G. Documentation

The results of the documentation from the research on the development of motorbike semantic ontology are in the form of writing contained in this report.

IV. Conclusion

Based on the discussion which has stated that it has, it can be adjusted as follows. This motorcycle ontology aims to collect data and classify motorbikes. The ontology is built based on the Methontology method with 16 classes, 13 object properties, 11 data properties, and 69 individuals (which are sample data).

In the evaluation process, ontology gives good results in answering the questions given. The development of good quality ontology designs can be done using the Methontology method because it can do so. The ontology of a motorcycle can be used as the basis for the development of a motorcycle knowledge system.

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