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Ontology-based Approach: A Smartphone Knowledge Representation

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Abstract

The development of technology in the modern era is currently increasing very rapidly so that it can make human work easier. One of the technologies that are often used by the community to meet the needs of life is a smartphone. The rapid development of smartphones has made people's purchasing power higher with existing criteria, ranging from brands, prices to features that potential buyers must consider in buying a smartphone. The lack of public knowledge also makes people difficult to pick a smartphone product that meets their criteria because of the many smartphone brands on the market. Ontology can be an alternative solution to explicitly describe information about smartphones. The construction of an ontology model is carried out using the classic methodology Methontology. The ontology that was built has 7 classes, 12 subclasses, 9 object properties, 2 data properties, and 92 instances. The ontology built can be utilized using SPARQL query with several search criteria on this ontology that can produce the output that the user wants and can represent knowledge from a set of concepts in the knowledge domain, in this case the smartphone and its relationship between these concepts.

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

1. Introduction

The development of technology in the modern era is currently increasing rapidly, so that it can facilitate human work. The development of a technology has begun to be widely used in people's lives in various aspects, for example aspects of the economy, education, and others. One of the technologies that are often used by the community in fulfilling the necessities of life is a smartphone. A smartphone is a communication device or cellular phone equipped with a digital provider. Cellular smartphone with more capabilities, ranging from resolution, features, to computing, including the operating system in it [1].

According to data quoted from eMarketer, smartphone users in Indonesia have increased drastically from year to year. In 2016 the use of smartphones in Indonesia stood at 65.2 million people, which increased by 14.8% in 2017, 10.3% in 2018, and in 2019 the total smartphone users in Indonesia were 92 million people. Smartphone is a basic need for everyone. Smartphones can help someone's job because they have many features and certain technologies. The rapid development of smartphones has made people's purchasing power higher with existing criteria, ranging from brand, price to features that prospective buyers must consider in buying a smartphone [2]. The many types of smartphones on the market pose a problem for the community, namely that there are still many people who buy smartphones that do not match their needs and specifications. The lack of public knowledge also makes people confused about choosing a smartphone product because of the many smartphone brands on the market. So that effort is needed to manage and classify information related to smartphones so that buyers find it easier to get that information. From these problems, an alternative solution that can be offered is the use of ontology. Ontology is an information representation technique that can express information explicitly and semantically in a structured and semi-structured manner [3]. Thus, if the knowledge about smartphones that has been obtained is gathered explicitly into the ontology scheme, the ease of organizing and managing data will be more guaranteed thanks to the ontology that is specific to the smartphone domain [4].

In this study, the authors propose a semantic web ontology modeling in the smartphone domain. The method applied in this research is the Methontology Method [5]. This research is useful to better understand the implementation of semantic ontology in building ontology models that represent the domain of knowledge about smartphones. This research is expected to be able to build a smartphone ontology model as a recommendation that has good design quality by utilizing the methodology methodology.

2. Reseach Methods

In developing the ontology model, the method used is the Methontology method. The Methontology method is a structured ontology development method that is used to build ontologies from scratch. Methontology is one of the ontology model development methodologies that have advantages related to the description of each activity that must be carried out in detai [6]. By using Methontology, the built ontology can be reused. The following are the stages of the Methontology method. The following are the steps in building an ontology [7]:

2.1 Specification

This stage aims to produce an informal, semi-formal, or formal ontology specification document written in natural language. This stage uses a set of intermediate representations or uses multiple competency questions .

2.2 Knowledge Acquisition

The Knowledge acquisition stage is an independent activity in ontology development, most of these stages are carried out simultaneously with the specification stage. Experts, books, and even other ontologies can be a source of knowledge that can be explained by interviews, brainstorming, and text analysis.

2.3 Conceptualization

This stage aims to compile a domain of knowledge in a conceptual model that describes problems and solutions in the vocabulary of the domains identified in the ontology specification activity [3]. The first thing to do is to write a Glossary of Terms. The terms cover concepts, instances, verbs, and properties. The Glossary of Terms identifies and collects all usable domains of knowledge. After almost finishing the Glossary of Terms, then classify the terms as concepts and verbs [8].

2.4 Integration

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

2.5 Implementation

At this implementation stage, the ontology design process is carried out starting, namely building classes, sub-classes, object properties, data properties, and individual or instance instances.

2.6 Evaluation

This stage aims to verify and validate the ontology, its software environment, and documentation relating to the frame of reference for each stage in its life cycle. Verification is checking the correctness of the ontology, both in the form of the correctness of the data, documents, and software that are used as references in the development of the ontology, while validation is to ensure the ontology, software, and documents are in accordance with the system of the original purpose for which the ontology was made.

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2.7 Documentation

At this stage, the ontology is documented informal definitions, and papers published in research and journals help important questions of the ontology being constructed. In addition, this stage will help develop ontologies that make it easier for developers to not need to build ontologies from scratch.

3. Result and Discussion

This section contains the result and discussion of the research and can be presented as description, charts or figures.

3.1 Specification

The purpose of the speciation phase is to produce informal, semi-formal, or formal ontologies of speciation instruments written in natural language, each using a set of intermediate representations or using competency questions. The following is a description of the smartphone ontology.

a. Domain: Smartphone

b. Date: Sept 18, 2020

c. Conceptualized by: I Wayan Gede Indrayasa

d. Implemented by: I Wayan Gede Indrayasa

e. Objectives: To build ontology models to facilitate the classification of smartphone

f. Level of Formality: Semi-formal.

g. Scope: Smartphone

h. Knowledge Sources: Internet (Bhinneka.com)

3.2 Knowledge Acquisition

In this knowledge acquisition process, most of the knowledge acquisition is carried out in the required specification stage with the ontology development process so that the results of the ontology built are expected to match the planned needs or specification [9]. In the acquisition phase of smartphone ontology knowledge 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. Identifies the structure to be detected (definitions, affirmations, etc.) and the types of knowledge each contributes (concepts, attributes, values, and relationships).

In this study, using smartphone data with the highest interested brands in Indonesia according to the International Data Corporation (IDC), namely Samsung, Oppo, Xiaomi, Vivo, and Realme. The data used in this study were obtained from a reliable internet source, namely Bhinneka.com. Bhineka.com[1] is an e-commerce company that is engaged in selling IT or technology devices. In this e-commerce, there are various kinds of outlets from bhineka.com which are widespread in several places in Indonesia so that they can reach distant places and facilitate delivery. One of the things that are highly rated and considered as very important at Bhineka.com is the facility that provides complete prices and specifications.

3.3 Conceptualization

The ontology conceptualization aims to organize and manage the knowledge acquired during the knowledge acquisition process. In structuring domain knowledge in a conceptual model that

[1] https://www.bhinneka.com/jual-smart-phone/3457276?sort=price&page=2

describes the problem and its solution in terms of the domain vocabulary identified in the ontology specification activity, we construct a complete one. The glossary identifies and collects all useful and potentially usable domain knowledge and their meaning. So the glossary identifies and collects all useful and potentially usable domain knowledge and is then implemented in the form of classes and subclasses as shown in Figure 1.

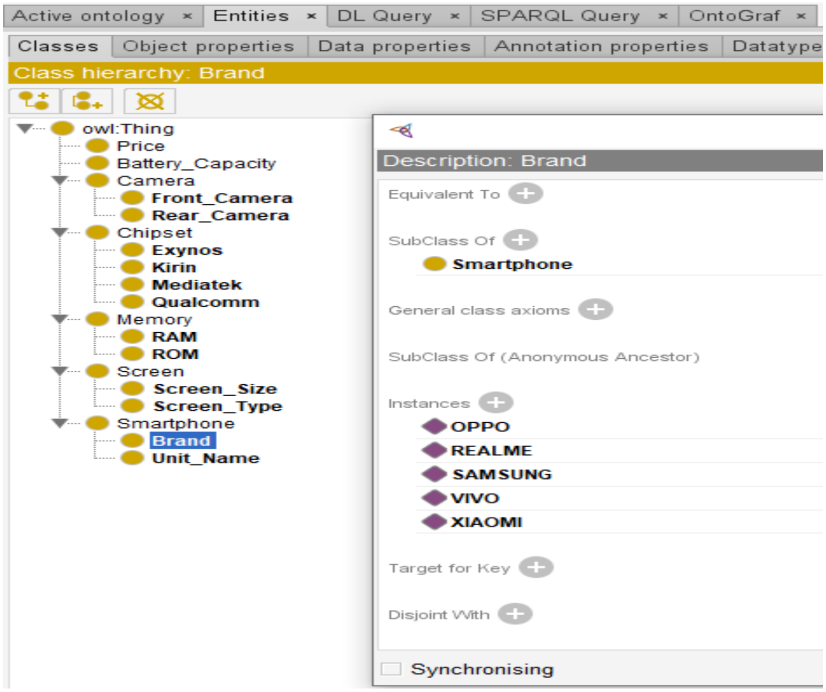

Figure 1 Class Hierarchy and Description Class Instances

3.4 Integration

At this stage, the definition that has been made in the ontology is reconsidered. The purpose of this consideration is to ensure that new and reused content sets are based on the same terms in order to be related. Then, researchers found ontology libraries that provide definitions of semantic terms and implementations that are coherent with the terms identified in the conceptual model so that there are no errors in determining relations.

3.5 Implementation

At the implementation stage, the authors used the Protégé 5.5.0 software and the Protégé Website. From the class that has been created in Figure 1, object properties can be formed in Figure 2, property data in Figure 3 and individuals and their relationships in Figure 4. For example in Figure 2 there are object properties "hasBrand" with the domain "Unit_Name" and Range "Brand. ". This can be interpreted as the domain "Unit_Name" as the subject, "hasBrand" as the predicate and Brand as the object.

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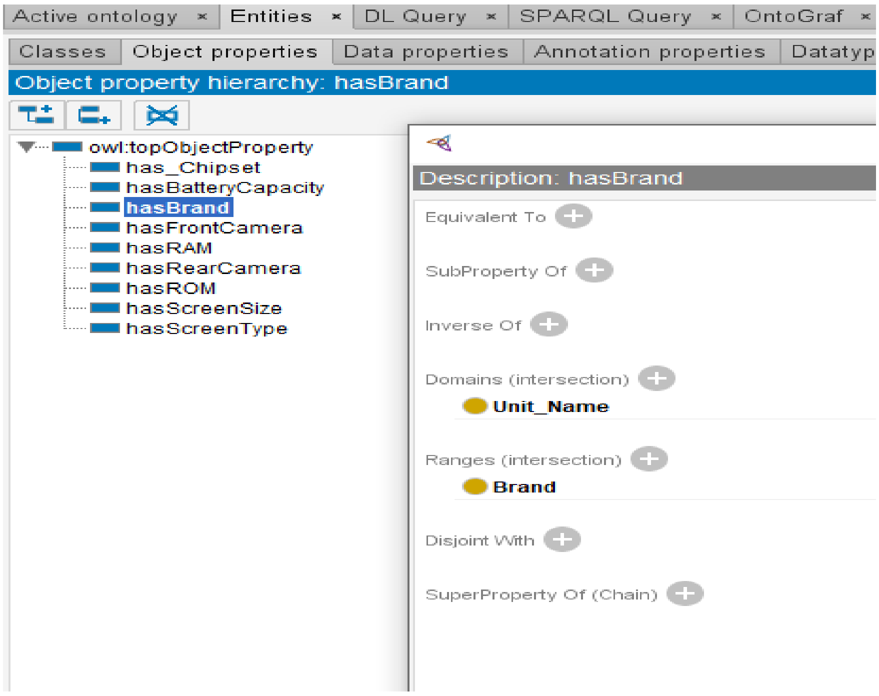

Figure 2 Object Properties and Description

Furthermore, in Figure 3, property data can be formed as individual data to be created. Here there are data properties "Has Price" as price data in the domain "Price" which is of type float.

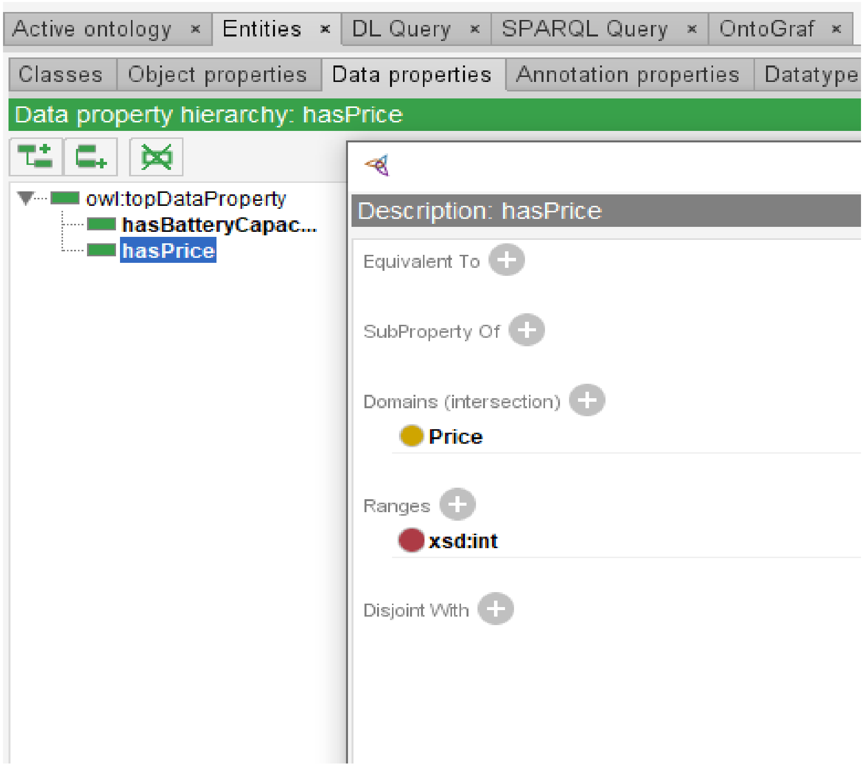

Figure 3 Data Properties and Description

In this study, 93 individual counts were formed which were obtained from the sample data on the Bhinneka.com[2] website. Here we can connect individuals to other individuals by filling in object

[2] Bhinneka.com

properties so that some individuals have the same criteria. At this stage we can also fill in data through data properties to fill in data that may not be the same as other individuals.

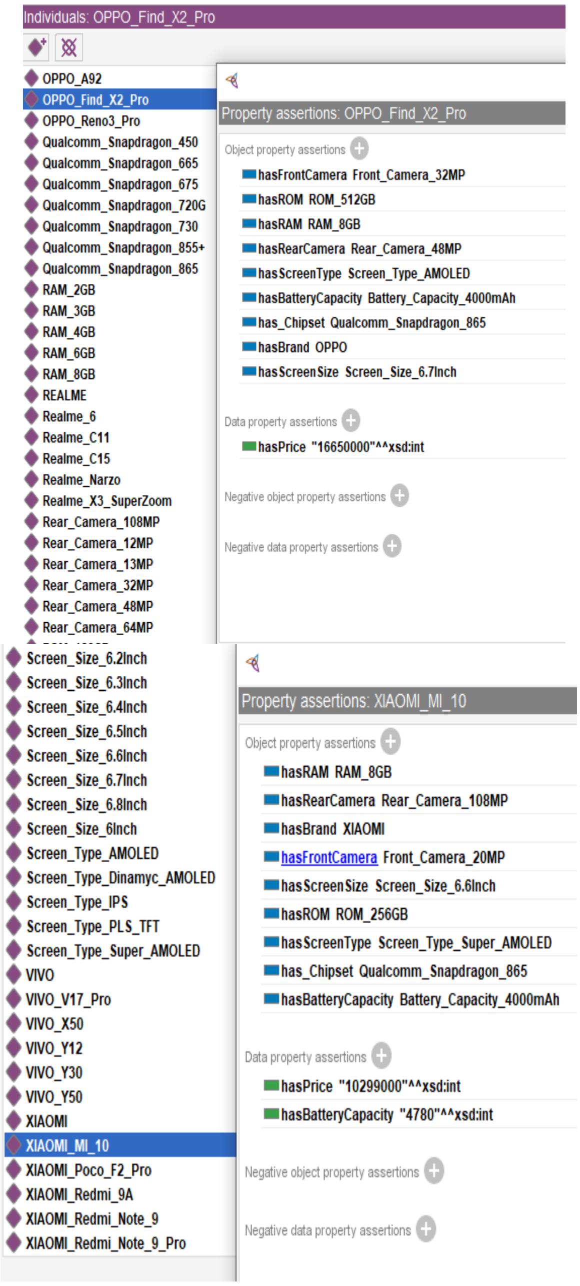

Figure 4 Individual Entities and examples of their relationships

3.6 Evaluation

The evaluation stage was carried out by the author to see the consistency of the relationship between the concept and smartphone. At this stage 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. At this evaluation stage, a search for smartphones that have 8GB of RAM is carried out. So we execute a query with the command finding "unit_name" as the subject with object RAM_8GB and related by object property which is "hasRAM". The results obtained after executing the query are that there are 15 smartphones shown in Figure 5.

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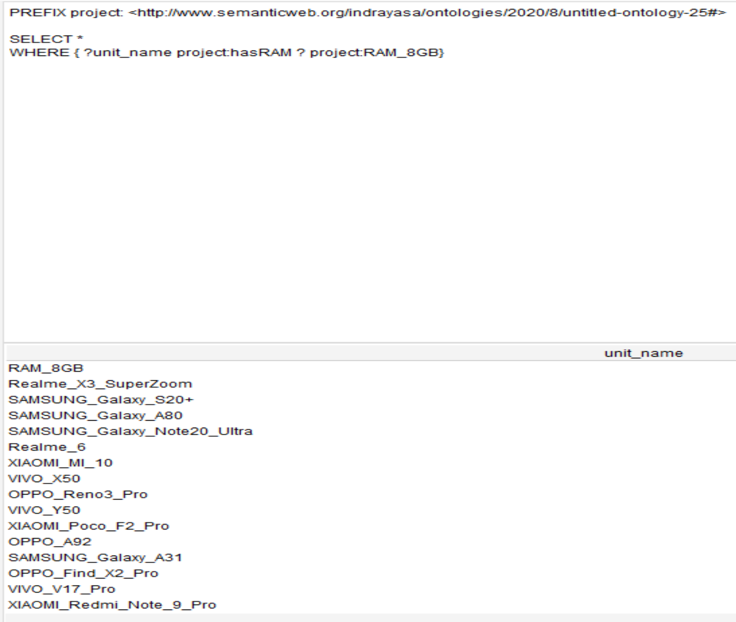

Figure 5 SPARQL Query 1 execution results

In Figure 6, we add the criteria from the query in Figure 5, which is to have 8GB RAM and a Qualcomm Snapdragon 856 chipset. The results obtained are that there are 3 smartphones out of 15 smartphones in Figure 5 above.

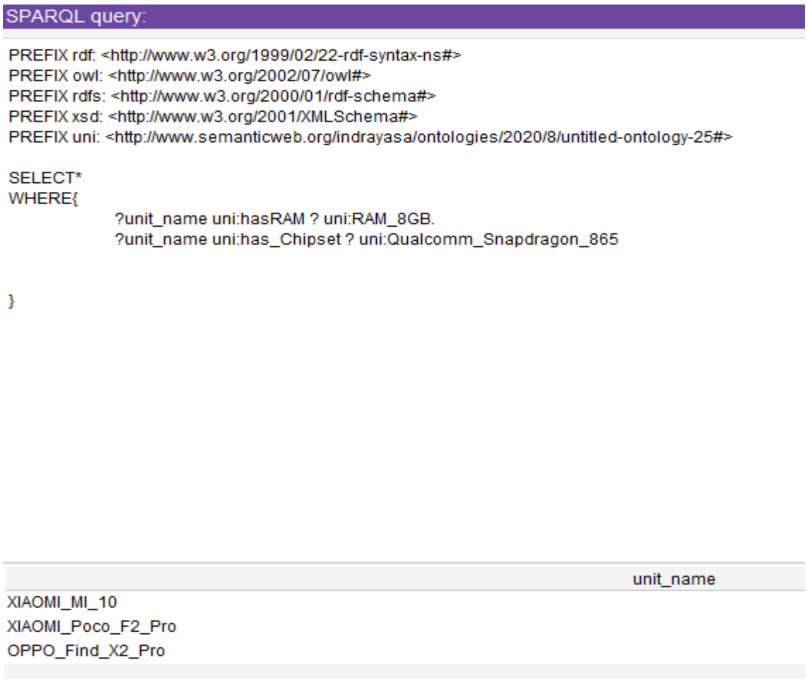

Figure 6 SPARQL Query 2 execution results

3.7 Documentation Stage

The results of documentation of the development of smartphone ontology are in the form of writing contained in this journal itself. The following is the ontology of this smartphone, which consists of 7 classes, 12 sub classes, 9 object properties, 2 data properties and 92 individuals.

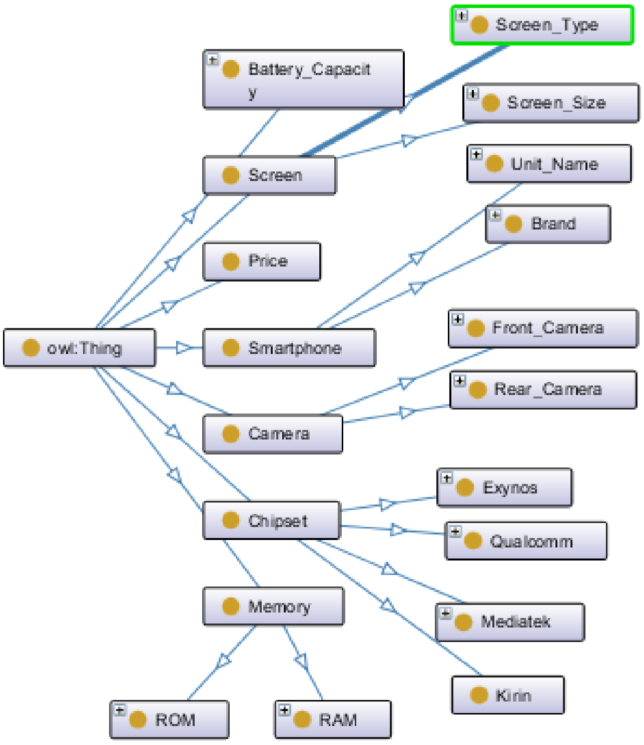

Figure 7 Ontograf

4. Conclusion

Smartphone ontology aims to collect data and facilitate knowledge management about smartphones. 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. This smartphone ontology was built using the Protégé 5.5.0 application which consists of 7 classes, 12 subclasses, 9 object properties, 2 data properties, and 92 individuals. In this study, the ontology that is built can help users search for smartphones according to the criteria and needs needed.

Searching using SPARQL with several search criteria on this ontology can produce the output that the user wants and can represent knowledge from a set of concepts in the knowledge domain, in this case, smartphones and their relationship between these concepts. Given that the ontology can also be developed from existing ontologies and ontologies so that it can be integrated with data from several other relevant ontologies into an ontology that will be developed [9]. Besides, for the future, this smartphone ontology can be implemented into a semantic web-based system.

References

[1] I. T. M. Daeng, N. Mewengkang, and E. R. Kalesaran, "Penggunaan smartphone dalam menunjang aktivitas perkuliahan oleh mahasiswa fispol unsrat manado," *Acta Diurna Komunikasi,* vol. 6, no. 1, 2017.

[2] A. Eryzha, S. Solikhun, and E. Irawan, "Sistem Pendukung Keputusan Rekomendasi Pemilihan Smartphone Terbaik Menggunakan Metode Topsis," *KOMIK (Konferensi Nasional Teknologi Informasi dan Komputer),* vol. 3, no. 1, 2019.

p-ISSN: 2301-5373
e-ISSN: 2654-5101

[3] K. D. P. Novianti and M. S. Wibawa, "Ontology Model untuk Tourist Information Retrieval," *E-Proceedings KNS&I STIKOM Bali,* pp. 164-169, 2017.

[4] A. Jounaidi and M. Bahaj, "Designing and implementing XML schema inside OWL ontology," in *2017 International Conference on Wireless Networks and Mobile Communications (WINCOM)*, 2017, pp. 1-7: IEEE.

[5] C. Pramartha, "Pengembangan Ontologi Tujuan Wisata Bali Dengan Pendekatan Kulkul Knowledge Framework," *SINTECH (Science and Information Technology) Journal,* vol. 3, no. 2, pp. 77-89, 10/28 2020.

[6] I. L. Koten and C. Pramartha, "Semantic Representation of Balinese Traditional Dance," *Jurnal Elektronik Ilmu Komputer Udayana,* vol. 8, no. 4, pp. 411-419, 2020.

[7] P. R. Ganeswara and C. R. A. Pramartha, "Ontology-Based Approach for Klungkung Royal Family," *Jurnal Elektronik Ilmu Komputer Udayana,* vol. 8, no. 4, pp. 497-505, 2020.

[8] M. Wardana and C. Pramartha, "Development of Semantic Ontology Modeling in Knowledge Representation of Balinese Gamelan Instruments," *Jurnal Elektronik Ilmu Komputer Udayana,* vol. 8, no. 2, pp. 145-152, 2019.

[9] C. Pramartha, J. G. Davis, and K. K. Y. Kuan, "Digital Preservation of Cultural Heritage: An Ontology-Based Approach," in *The 28th Australasian Conference on Information Systems*, Hobart, Australia, 2017, pp. 1-12, 2017.

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