Jurnal Elektronik Ilmu Komputer Udayana
Volume 8, No 4. May 2020

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

Ontology-Based Approach for Klungkung Royal Family

Putu Ryan Ganeswara[1] , Cokorda Rai Adi Pramartha[2]

1. *Department of Computer Science, Faculty of Mathematics and Natural Science, Udayana University*

E-mail : ganeswararyan@gmail.com [1], dan cokorda@unud.ac.id [2]

Abstract

Kawitan genealogies form to strengthen family relations by staying in line with their ties. Today, there are many Balinese Hindu searches their heritance. This due to no explicit documentation about the family tree and the Balinese Hindu relies on people memories. To overcome this problem, we develop the ontology of the Family Tree Naritan Kawarya Narem Dalem Benculuk Tegeh Kori with Forward Chaining and Backward Chaining Search Method can overcome problems related to marriage lineage. By using the structured data in the form of an ontology, the computer agents and human will be able to find information related to their genealogy easily, so that there are no more people who are confused with their heritance. The ontology evaluation was conducted on the Nararya Dalem Benculuk Tegeh Kori's family tree. The initial result gave positive feedback toward further development of this ontology.

Keywords : *Ontology, Family Tree, Methontology*

I. INTRODUCTION

The Balinese kingdom is the term for a series of Hindu-Buddhist kingdoms that had ruled in Bali, in the Lesser Sunda Islands, Indonesia. The kingdoms are divided into several periods according to the dynasty that ruled at that time. With the history of the original Balinese kingdom stretching from the beginning of the 10th century to the beginning of the 20th century, the Balinese kingdom exhibits a sophisticated Balinese palace culture where the elements of spirit and ancestor respect are combined with Hindu influences, adopted from India through ancient Javanese intermediaries , developing, enriching and shaping Balinese culture.

Although the kingdom of Bali has been established for a long time, but the lack of data and sources that record the royal footprints and the government at that time led to the need for information at this time which information is very important and has a high historical value, because of the lack of information available about royal kingdom in Bali. minimal then any information that can still be found must be described and maintained properly. The use of ontology as an information representation technique is the choice of solution in this problem. Ontology can be used to express information explicitly and semantically both structured and semi-structured.

METHONTOLOGY is an ontology model development methodology, where this methodology has advantages related to the description of each activity that must be carried out in detail. In addition, METHONTOLOGY also has the ability that the built ontology can be reused for further system development.

Therefore, a study is proposed to build an ontology model that represents the domain of knowledge about the lineage of the kings of Klungkung. This research is expected to be able to build ontology models that have good design quality by utilizing the METHONTOLOGY methodology. "

A. Digital Cultural Heritage

Digital heritage is the use of digital media in services to preserve cultural or natural heritage. The Charter on Preservation of Digital Heritage UNESCO defines digital cultural heritage as embracing "cultural, educational, scientific, and administrative resources, as well as technical, legal, medical, and other types of information created digitally, or converted to digital forms from analogous resources that are there is ".

B. The History of The Klungkung Kingdom

The beginning of the formation of kawitan Sri Kresna Kepakisan in Bali, the origin of the kepakisan he said fern, which means nails. The title of bitterness is given to Brahmins who are assigned as kings (dalem) or knights. The title of kepakisan given to the knights was Sira Arya Kepakisan. He is a descendant of Sri Jayasabha, descended from the descendants of Maha Raja Airlangga, king of Kahuripan (Java). The title nail in Java was first used by Susuhunan Kartasura: Paku Buwono I in 1706 AD.

In the chronicle of Dalem Mpu Wira Dharma has three sons, namely: MPU Lampita, MPU Adnyana, MPU Pastika. Furthermore, MPU Pastika had two sons, namely: MPU Kuturan, boarding at Lemah Tulis and MPU. Went to Daha and became a royal priest (bhagawanta) of the king Airlangga and was associated with the story of a very famous candidate in Bali. Then MPU Beradah has a son named Mpu Bahula who then marries Ratnamanggali. From this marriage several sons were born: MPU Panawasikan, MPU Asmaranatha, MPU Kepakisan and MPU Sidimantra. Finally, MPU Panawasikan has sons: MPU Angsoka, MPU Nirartha. MPU Kepakisan which has four sons, namely: three sons and a daughter. The youngest son Mpu Kresna Kepakisan was appointed king in Bali. Thus Sri Kresna Kepakisan who became king in Bali was from the brahmin descendants whose nobility was changed into kratrya or from Danghyang / Mpu to become Sri namely Sri Kresna Kepakisan.

In his government, he was accompanied by Ki Patih Wulung who served as Mangku Bumi. The capital of the kingdom was moved from Gelgel to Samprangan (Samplangan). The Samprangan area was chosen because during the Gajah Mada expedition, the village of Samprangan had historical significance, namely as a Gajah Mada camp and a place to set up a strategy to attack the Bedahulu kingdom. In reality it shows that the distance of the village of Bedahulu to Samprangan is only about 5 km.

From Babad Dalem it is known that in running the government as a representative of Majapahit on the island of Bali Dalem Sri Kresna Kepakisan is equipped with royal greatness clothing and a keris named the Ganja Dungkul which provides a cultural concept that combines Javanese and Balinese culture, and the sign of greatness functions as a symbol or a symbol of legitimate power. Dalem Sri Kresna Kepakisan was married to two, namely the first Ni Gusti Ayu Tirta, the daughter of Arya Gajah who gave birth to the first son named Dalem Wayan (Dalem Samprangan), the second son named Dalem Di-Madia (Dalem Tarukan) Dewa Ayu Wana (daughter, died as a child), and the youngest son was Dalem Ketut (Dalem Ketut Ngulesir). From his second wife Ni Gusti Ayu Kuta Waringin is the daughter of Arya Kutawaringin, who gave birth to Dewa Tegal Besung. The reign of Sri Kresna Kepakisan in Bali was the beginning of the formation of a new dynasty, namely the Kresna Kepakisan dynasty which then ruled in Bali until the beginning of the 20th century (1908) which became the forerunner of the kawitan Sri Kresna Kepakisan in Bali.

C. Semantic Web

Semantic Web is a recent generation Web that can be used to represent information so that it can be utilised by machines not only for display purposes, but for automation, integration, and reuse throughout applications. This has become one of the hottest R&D topics in recent years in the AI community, as well as in the Semantic Web1 Internet community is an important W3C activity.

Semantic Web is about making the Web more machine-understandable. It's also about building the right infrastructure for smart agents to run on the Web to carry out complex actions for its users. To do that, agents must retrieve and manipulate related information, which requires unlimited agent integration with the Web and make full use of existing infrastructure (such as messaging, security, authentication, directory services, and application service frameworks). In addition, the Semantic Web is about explicitly declaring knowledge embedded in many Web-based applications, integrating information in an intelligent way, providing semantic-based access to the Internet, and extracting information from text. Ultimately, Semantic Web is about implementing reliable, large-scale Web service interoperations, to make such services interpretable by computers to create machine-friendly and interoperable Web services that can be found, executed, and compiled by intelligent agents automatically [1-3].

D. Ontology

Ontology, is a vocabulary consisting of a composition of statements that define a concept, relationships and boundaries of a specific area within the scope of science. Ontology is modeled using the Ontology Web Language (OWL), which is a derivative of RFDS, which is more expressive in defining the relationships and

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

cardinalities of each class. Ontology has extensively been used in the cultural heritage domain to represent heritage resources in the digital form [4-6].

E. RDF dan RDF Schema

XML provides an easy-to-use syntax to encode all types of data exchanged between computers, using XML schemas to prescribe data structures. However, because it does not provide prior interpretation of the data, it does not contribute much to the semantic aspects of the Semantic Web. To provide a machine interpretation of Web data, a standard model is needed to illustrate facts about Web resources. Such a standard model can be determined using RDF and RDF Schema.

The RDF model for representing data about "things on the Web" (resources) is a model of triplets and a semantic network OA V. The description of resources in RDF is a list of statements (triplets), each expressed in a Web resource (object), one of its properties (attributes), and the value of the property. Values can be literals (text), or other resources. Each RDF description can also be represented as a graph with a directional label (semantic network), which is partly equivalent to the RDF statement. Figure 1 shows some of these triplets and the corresponding graph.

RESOURCE	PROPERTY	VALUE
http://www.music.org/albums#EC_Unplugged	author	"Eric Clapton"
http://www.music.org/albums#EC_Unplugged	title	"Unplugged"
http://www.music.org/albums#EC_Unplugged	label	"Reprise/WEA"
http://www.music.org/albums#EC_Unplugged	year	"1992"
http://www.music.org/albums#EC_Unplugged	content	http://www.music.org/contents#Acoustic3
http://www.music.org/contents#Acoustic3	type	"acoustic"
http://www.music.org/contents#Acoustic3	recording	"live"
http://www.music.org/contents#Acoustic3	listening	"easy"

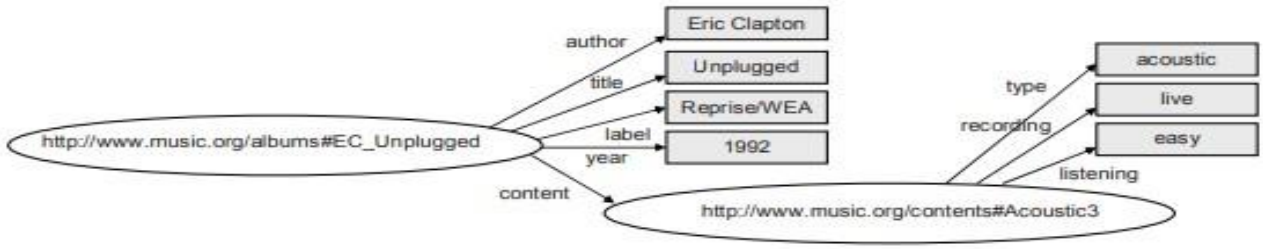

Fig. 1. Examples of RDF resources, properties, and values, and corresponding graphs

The RDF model itself only provides a domain-neutral mechanism to describe individual resources. It does not define (a priori) the semantics of any application domain, nor does it make assumptions about a particular domain. Determining domain and semantic-specific features, i.e., ontology, requires additional facilities. RDF itself is used to illustrate ontology examples, while the RDF Scheme encodes ontologies.

The RDF Schema (RDFS) provides XML-based vocabulary to determine classes and their relationships, to define properties and relate them to classes, and to enable taxonomic creation. To do all this, RDFS uses frame-based modeling primitives such as Class, subClassOf, Property, and subPropertyOf. The concept of Resources occurs at the root of all hierarchies and taxonomies.

RDF (S) provides a standard model for describing facts about Web resources, but modelers often need richer and more expressive primitives to determine the formal semantics of Web resources. RDFS is quite simple compared to the language of complete knowledge representation. For example, one cannot state in RDFS that "this class is equivalent to this other class," and cannot determine the limits of cardinality [7].

F. SPARQL

SPARQL is a query language for RDF. RDF Graph is composed of a triple formed from Subjects, Predicates and Objects, RDF can be defined in RDF Concepts and Abstract Concept Syntax. This triple can come from a variety of sources. for Instance can be obtained directly from the RDF document, it can be

concluded from the triple RDF. RDF expressions can be saved in other formats such as XML and Relational Database [8, 9].

SPARQL is a query language for getting information from RDF Graph. which provides the following facilities :

1) Extract information in the form of URIs, Blank Nodes and Literals.
2) Extract RDF Subgraph.
3) Build a new RDF Graph based on query graph

As a data access language it is suitable for local and remote use.

II. RESEARCH METHODS

This ontology will be built using the METHONTOLOGY method, METHONTOLOGY itself is one of the methodologies of developing an ontology model, where this methodology has advantages relating to the description of each activity that must be carried out in detail. In addition, METHONTOLOGY also has the ability that the built ontology can be reused for further system development [10, 11] . Some of the steps that must be carried out in this method include the following :

A. Specification

The purpose of the specification phase is to produce informal, semi-formal or formal ontology specification documents written in natural language, each using a set of intermediate representations or using competency questions. On this stage, an extensive discussion made among the ontology engineers and the royal family knowledgeable domain. The purpose and scope to develop the ontology models to facilitate the classification of the Klungkung's royal family specified in this stage.

B. Knowledge Acquisition

Knowledge acquisition is an independent activity in the ontology development process. Most of the acquisitions are carried out in conjunction with the requirements specification phase and decrease as the ontology development process moves forward. Knowledge acquisition from the cultural heritage expert through a semi-formal interview conducted in order to develop an initial draft of the requirements specification document. Analysis of informal texts, to study the main concepts given in the book and study handbook. A brief structure of the family's tree data has been studied and the follow by the formal text analysis. On the formal text analysis, the first thing to do is to identify the structure that will be detected (definition, affirmation, etc.) and the type of knowledge contributed by each (concepts, attributes, values, and relationships)

C. Conceptualization

In compiling domain knowledge in a conceptual model that describes the problem and its solution in terms of the domain vocabulary identified in the ontology specification activity, we construct a complete Glossary of Terms that includes concepts, instances, verbs, and properties as in Figure 2. So, the Glossary identifies and gather all useful and potentially usable domain knowledge and meaning.

Concept Name (Class)	Relation (Object Properties)	Instances Attributes (Data Properties)
Banjar	-	-
Fungsi	-	-
Generasi	-	adalahGenerasiKe
Kasta	-	-
JenisKelamin	-	-
Nama_Lengkap	adalahAnakDari, adalahCucuDari, adalahEyangDari, adalahEyangDari, adalahKeturunanDari, adalahOrangTuaDari, adalahPasanganDari, memilikiAnak, memilikiCucu, memilikiJenisKelamin, memilikiKasta, memilikiNamaAsli, memilikiNamaSetelahMenikah, memilikiSaudara, memilikiTempatTinggal, MenikahDenganKastah, menikahKe	adalahGenerasiKe, memilikiGelar, memilikiNamaKeluarga, memilikiNamaPemberian, memilikiTahunAkhirPemerintahan, memilikiTahunAwalPemerintahan, memilikiTahunLahir, memilikiTahunMenikah, memilikiTahunMeningggal, memilikiTahunPindah
Status_Perkawinan	-	memilikiTahunMenikah
Tahun_Menikah	-	memilikiTahunMenikah
Tahun_Akhir_Pemerintahan	-	memilikiTahunAkhirPemerintahan
Tahun_Meninggal	-	memilikiTahunMeninggal
Tahun_Awal_Pemerintahan	-	memilikiTahunAwalPemerintahan
Tahun_Lahir	-	memilikiTahunLahir
Desa	-	-
Ibukota	-	-
Kabupaten	-	-
Kecamatan	-	-
Pura	-	-
Puri	-	-

)

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

Fig. 2. Term Table

- Concept Name (Class) : is the class used.
- Banjar : Banjar, is the division of administrative territory in the Province of Bali, Indonesia under the Village or Village, at the level of the Five Pillars of the Community.
- Fungsi : The function in this case indicates that there is a special position in the class that is defined or not.
- Generasi : the time of the people of one life force.
- Kasta : class (level / degree) of people in Hindu religious society.
- JenisKelamin : is a designation between male and female.
- NamaLengkap : is someone's name.
- StatusPerkawinan : show marital status.
- TahunMenikah : shows when someone is married.
- TahunAkhirPemerintahan : shows the end of a king's rule.
- TahunMeninggal : shows the year of death of a king or royal family.
- TahunAwalPemerintahan : shows the early reign of a king.
- TahunLahir : shows the year of birth of the king and the royal family.
- Desa : an area that is inhabited by a number of families that have their own governmental systems.
- Ibukota : central government in an area.
- Kabupaten : the second level autonomous region headed by the regent.
- Kecamatan : the regency (city) area which carries several villages, is headed by a camat.
- Pura : place of worship of Hindus.
- Puri : palace/residence.

Kelas Asal	Properti Obyek	Inverse	Kelas Tujuan
Nama_Lengkap	adalahAyahDari	adalahAnakDari	Nama_Lengkap
Nama_Lengkap	adalahEyangDari	adalahCucuDari	Nama_Lengkap

Fig 3. Inverse Class

D. Integration

Consider the reuse of definitions already built into ontology.

- Check meta-ontology to choose one that is more in line with the concept. The aim is to guarantee that new and reused sets of definitions are based on the same basic set of terms.
- Finding out which ontology libraries provide definitions of semantic terms and their implementation is coherent with terms identified in conceptualization.

E. Implementation

In its implementation we use the Protege 4.3 application and webprotege.stanford.edu, at first we used the Protege 4.3 application but in the process where not all of the groups worked and only a few people used it so that webprotege.stanford.edu was used so that all could work together so that the making of Balinese Gamelan ontology could done together and hopefully can be completed faster than using the previous Protege 4.3 application. Each ontology section is defined according to the results of each task stage in METHONTOLOGY, where concepts are defined as classes (Figure 4), ad hoc binary relations are defined as object properties (Figure 5), class attributes and instance attributes are defined as datatype properties (Figure 6) , and instances are defined as individuals (Figure 7).

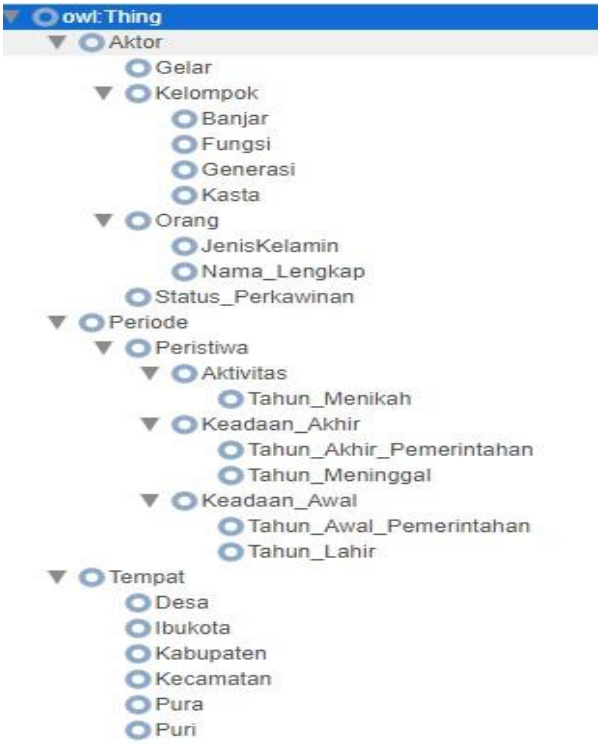

Fig 4. Class of the Lineage Ontology of the Kings of Klungkung

Fig 5. Object Properties of the Klungkung Lineage Ontology of Kings

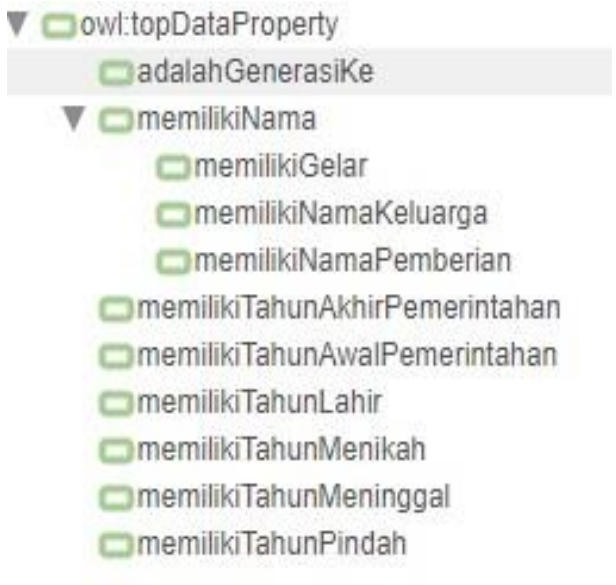

Fig 6. Data Properties of the Klungkung Lineage Ontology of Kings

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

Fig 7. Individuals from the Klungkung Kings Lineage Ontology

F. Evaluation

At this stage we try to do the evaluation process by querying the Protege 4.3 application, where in the query process we use SPARQL Query. In this query process we create a new PREFIX called genealogy with an IRI Ontology address that matches the address in the application protege. Making PREFIX is intended so that the query command that we enter is directed to the file or address that matches the ontology that we have built. Following are some of the query results that have been carried out:

List all instances that are in the Generation class

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 silsilah: <http://www.semanticweb.org/user/ontologies/2019/3/untitled-ontology-4#>

SELECT ?Generasi
        WHERE {?Generasi rdf:type/ rdfs:subClassOf* silsilah:Generasi }
```

Fig. 8. Query Class Generasi

After the query process is carried out above, the query results are as follows:

Generasi
X
I
XI
VII
II
V
VIII
III
IX
VI
IV
XII

Fig 9. Generated Query Class Results

The query results above indicate what instances are included in the Generation class. There is fourteen individuals or instances inside the Generasi sub class. We can query not just for look what individuals inside some class in the ontology but we can query some more question about the inside of the ontology.

G. Documentation

The results of the documentation of the Klungkung Kings Lineage study are in the form of writings contained in this report itself.

III. RESULT AND DISCUSSION

A brief structure of the royal family's tree data has been collected and the studied, and the follow by the analysis to grab an understanding. Conceptualization of ontology aims to organize and manage the knowledge acquired during the knowledge acquisition process. When the conceptual model is built, the methodology proposes to change the conceptual model into a formal model, which is then implemented with the language of ontology implementation. The conceptualization of the Klungkung royal lineage ontology was built using the METHONTOLOGY methodology. The development of this ontology does not use all the existing stages because at certain stages these components cannot be defined.

The conceptual design of ontology that has been done using METHONTOLOGY is then formalized using Protg 4.3 and web-based ontology applications (http://webprotege.stanford.edu). In Protg 4.3 software each ontology section is defined according to the results of each task stage in METHONTOLOGY, where concepts are defined as classes, ad hoc binary relations are defined as object properties, class attributes and instance attributes are defined as datatype properties, whereas on webprotege.stanford. edu we collaborate in defining instances as individuals. Ontographs of this ontology can be seen in Figure 10.

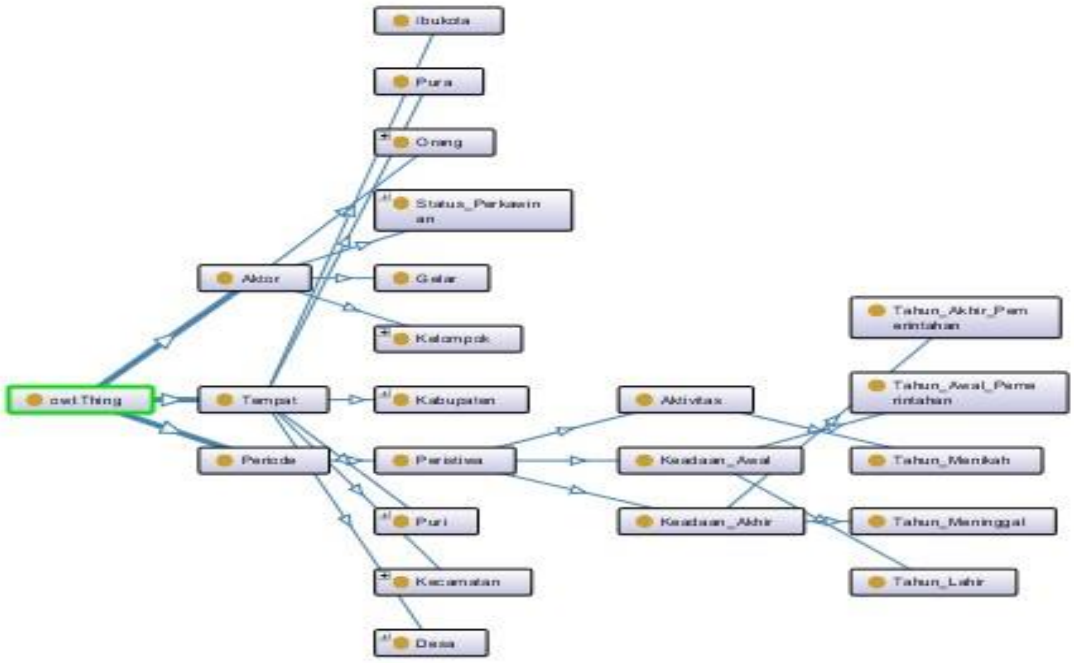

Fig. 10. Ontograf from the Ontology

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

The pedigree ontology of the Klungkung kings was built based on the METHONTOLOGY methodology. From the ontograph there are 28 classes which contain 25 sub classes, then there are 18 object properties and 11 data property properties, in addition there are also instances or individuals totaling 324 data. With the combination of classes, data properties, object properties, and individuals, a Kltung royal family ontology can be built.

IV. CONCLUSION

Based on the discussion that has been presented, it can be concluded as follows. The semantic Ontology of the Klungkung royal family lineage was developed with the aim of providing information related to the Klungkung royal lineage using appropriate data based on the Klungkung royal lineage file, as well as other available sources.

The pedigree ontology of Klungkung kings that was built based on the METHONTOLOGY methodology has classes, datatype properties, and object properties. Development of ontology to get the quality of ontology design can be done because METHONTOLOGY has the ability to do that. In addition, the ontology of the Klungkung royal family lineage can then be used as a basis for the development of the semantic lineage knowledge system of the royal family in Bali and other regions.

REFERENCES

[1] T. Berners-Lee, J. Hendler, and O. Lassila, “The Semantic Web,” *Scientific American*, pp. 34-43, 2001.

[2] C. R. A. Pramartha, “Assembly the Semantic Cultural Heritage Knowledge,” *Jurnal Ilmu Komputer,* vol. 11, no. 2, pp. 83-95, 2018.

[3] C. Pramartha, J. G. Davis, and K. K. Y. Kuan, "A Semantically-Enriched Digital Portal for the Digital Preservation of Cultural Heritage with Community Participation," *Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection: 7th International Conference, EuroMed 2018, Nicosia, Cyprus, October 29 – November 3, 2018, Proceedings*: Springer International Publishing, 2018.

[4] R. Brownlow, S. Capuzzi, S. Helmer, L. Martins, I. Normann, and A. Poulovassilis, “An Ontological Approach to Creating an Andean Weaving Knowledge Base,” *J. Comput. Cult. Herit.,* vol. 8, no. 2, pp. 1-31, 2015.

[5] C. Pramartha, and J. G. Davis, "Digital Preservation of Cultural Heritage: Balinese Kulkul Artefact and Practices," *Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection: 6th International Conference, EuroMed 2016, Nicosia, Cyprus, October 31 – November 5, 2016, Proceedings, Part I*, M. Ioannides, E. Fink, A. Moropoulou, M. Hagedorn-Saupe, A. Fresa, G. Liestøl, V. Rajcic and P. Grussenmeyer, eds., pp. 491-500, Cham: Springer International Publishing, 2016.

[6] C. Pramartha, J. G. Davis, and K. K. Y. Kuan, "Digital Preservation of Cultural Heritage: An Ontology-Based Approach." pp. 1-12, 2017.

[7] L. Yu, *A Developer's Guide to the Semantic Web*, Berlin [Germany]: Springer, 2014.

[8] B. DuCharme, *Learning SPARQL*: O'Reilly Media, 2013.

[9] S. Harris, Garlik, and A. Seaborne. "SPARQL 1.1 Query Language," 14 February, 2016; https://www.w3.org/TR/2013/REC-sparql11-query-20130321/.

[10] M. Fernández-López, A. Gómez-Pérez, and N. Juristo, “Methontology: from ontological art towards ontological engineering,” 1997.

[11] J. Park, K. Sung, and S. Moon, "Developing graduation screen ontology based on the METHONTOLOGY approach." pp. 375-380.