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Question Answering System Using Semantic Reasoning on Ontology for The History of The Sumedang Larang Kingdom

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Abstrak−Belajar sejarah dapat melatih kita untuk memahami urutan suatu peristiwa serta meningkatkan rasa nasionalisme kepada generasi muda. Namun, generasi muda saat ini memandang belajar sejarah sebagai sesuatu hal yang membosankan dan tidak penting. Belajar sejarah dianggap membosankan karena memiliki stereotip harus belajar dengan membaca tulisan yang panjang di buku. Maka dari itu pada penelitian ini dibangun Question Answering System (QAS) menggunakan ontology untuk mendapat informasi sejarah serta mengenal budaya. Dengan QAS, pengguna tidak perlu membaca kalimat panjang serta menghabiskan banyak waktu dalam mencari informasi seputar sejarah, pengguna juga dapat mengajukan pertanyaan dalam bahasa alami tanpa harus memerhatikan struktur kalimat. Ontology dipilih untuk bisa membangun basis pengetahuan pada domain sejarah dan SPARQL digunakan untuk mencari jawaban dalam ontology dengan menggunakan semantic reasoning. Dibangunnya sistem ini diharapkan tidak hanya bisa membantu mengenalkan sejarah Kerajaan Sumedang Larang, namun juga mampu meningkatkan daya tarik pariwisata budaya di Indonesia. Hasil evaluasi dengan uji akurasi sistem menunjukkan hasil sebesar 87%.

Kata Kunci: Sistem Tanya Jawab; Ontology; SPARQL; Sejarah; Kerajaan Sumedang Larang

Abstract−Studying history can train us to understand the sequence of events and increase a sense of nationalism in the younger generation. However, today's young generation views studying history as boring and unimportant. Studying history is considered boring because it has the stereotype of having to learn by reading long writings in books. Therefore, in this study, a Question Answering System (QAS) was built using an ontology to get historical information and get to know the culture. With QAS, users don't have to read long sentences and spend a lot of time searching for historical information, users can also ask questions in natural language without having to pay attention to sentence structure. The ontology was chosen to be able to build a knowledge base on the historical domain and SPARQL was used to find answers in the ontology using semantic reasoning. The construction of this system is expected not only to help introduce the history of the Sumedang Larang Kingdom but also to increase the attractiveness of cultural tourism in Indonesia. The results of the evaluation with the system accuracy test showed a result of 87%.

Keywords: Question Answering System; Ontology; SPARQL; History; Sumedang Larang Kingdom

1. INTRODUCTION

History is past events that are then studied based on sources of information recorded by historians for research, then written as historical narratives. Studying history not only makes us understand what has happened, but also trains logical and critical thinking. The ability to understand the sequence of events with existing facts and evidence can make us look at an event from various perspectives. This ability can be a provision in the present and the future in receiving information to be able to distinguish between facts and hoaxes. Studying history can also increase the sense of nationalism of the nation's future successors. But unfortunately, today's generation thinks that studying history is not important and boring [1].

Today's young generation or what we call millennials, not many of them are interested in knowing or studying history, especially from their own country due to globalization and exposure to western culture which they think is more interesting and modern. Studying history sounds old-fashioned, uninteresting, and boring to them. Moreover, learning history is done by reading dozens of paragraphs in history textbooks, listening to the explanations of history teachers who tell stories in a boring way, or other conventional methods that are less effective [2], [3]. Of course, learning history sounds less interesting than playing a more modern and interactive smartphone. Moreover, the pandemic has resulted in a change in the way of learning from offline to online. This requires us to be able to make good use of online media.

There have been several studies that have made alternatives to make history learning more interesting. Taufani, et al [3] offer history learning using applications. Historical material can be accessed through the iOS application which contains stories, explanations, photos, and audio that can explain the history of the kingdom. Azmi [4] chose to use film to tell the history he raised. Tanjung and Sitompul [5] use storytelling games, users can play as characters in the game so that players can play while learning. D. A. Fitriningtiyas' [2] utilizes the Google Classroom platform which is easy to access and use in teaching history lessons. The learning media offered are of course interesting. But what if the user wants to ask about a specific history and only wants a specific answer? Of course, it will be difficult if you have to re-read the material on the application, re-watch movies or play games again. Using search engines like Google or Bing often gives answers that are not specific and we need to read a few more sentences to get the answer we want or sometimes we don't even find the answer we want. A suitable system for obtaining specific answers in a particular domain is the Question Answering System (QAS).

With the Question Answering System (QAS), users can ask questions in natural language that ask for specific information [6]. The system looks for the answers that the user wants in a way, incoming user questions will be

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categorized based on certain groups then answers will be sought from documents owned by the system [7]. User questions and documents owned by the system must of course be understood by the system so that the system can understand what answers are suitable for user questions using natural language. So it is necessary to make a representation of knowledge about the history of the system.

Ontology is a model used to understand, process, and create knowledge from a particular domain that can be understood by machines by making knowledge a concept [8], [9]. The advantage of using an ontology is its ability to analyze questions in natural language so that the system can give the correct answer [10]. QAS has been applied in various fields such as the biomedical field [11]. This QAS named Olelo accepts questions that ask for answers in the form of factoids (short answers), definitions (explanations of a concept), and summaries (short stories/conclusions of a topic). The way it works is by getting keywords and then performing a query to get the appropriate documents. Furthermore, [6] built a QAS that can access chemical data from knowledge graphs. This QAS uses the implementation and evaluation of the proof-of-concept model. In the field of agriculture, there are [12] who build QAS by combining Natural Language Processing (NLP) and the semantic web. In the field of education, there are [13], QAS is built by using keywords and semantic similarities to build document groupings to get answers. Of all the QAS studies above, none of them have discussed the topic of history.

In this study, we built a historical QAS focused on the Sumedang Larang Kingdom. Knowledge representation is built using ontology. It is hoped that this question answering system can help users learn the history of the Sumedang Larang Kingdom. In addition, this system can increase users' curiosity about history and culture, so that users are interested in visiting cultural tourist attractions.

2. RESEARCH METHODOLOGY

2.1 System Design

As shown in Figure 1, the system has several stages in providing answers. Three main processes run, namely, text preprocessing, word identification, and building SPARQL queries. The process begins with the user asking questions in natural language and does not have to use grammatical sentence structures. Then text preprocessing is carried out, this process is carried out to prepare the data before going to the next stage. The result of this process is the words that have been tagged. The next process is word identification, where words will be identified, whether words include keywords, property words, or object words. After the word is identified, the system selects the appropriate SPARQL query formation, then the system runs the query to get the answer from the ontology. The results of this query are provided as an answer to the user.

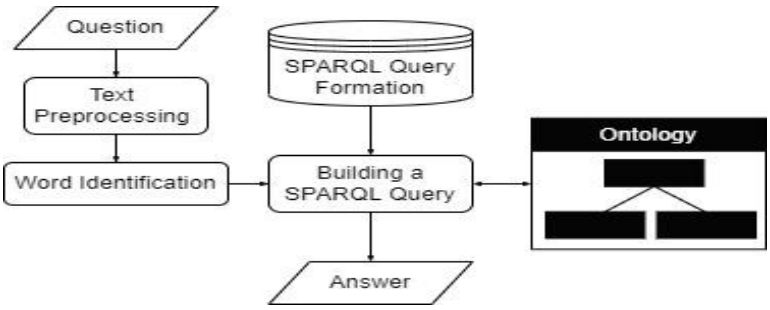

Figure 1. System Design

2.2 Question Answering System

QAS is a system that can accept questions from users in natural language to request specific information. QAS uses machine learning models and natural language processing tools to interpret the questions asked by users and convert the questions into machine-understandable queries [6].

The answer from the QAS can be a word or a piece of text taken from a document/web/database/knowledge base. The overall QAS tasks are 3: 1) analyze natural language questions posed to get machine understandable queries, 2) process and analyze documents to get the right answers, and 3) provide answers. Natural Language Processing (NLP) techniques are needed in QAS because natural language questions will be converted into queries [12].

2.3 Ontology and SPARQL Query

Ontology is a model used to understand, process, and create knowledge from a particular domain. The advantage of ontology is its ability to analyze questions in natural language so that the system can provide the right answer [10]. The thing that encourages the use of ontology in QAS is that the machine can understand the information and data in the database and the relationship between one information and another. Thus, the machine can provide intelligent answers because it has knowledge of the domain [14]. In this study, we use Protégé to construct the ontology. Protégé is one of the most popular open sources for ontology development [15].

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To get information from ontology, we use SPARQL to get answers by semantic reasoning. SPARQL is a query language used to access and manage semantic data. The data will be saved in RDF (Resource Description Framework) format [7], [16]. SPARQL is a tool to find answers to processed questions.

2.4 Text Preprocessing

Text Preprocessing is the process of preparing text before it is processed by the system. This stage requires several techniques from NLP which are expected to help facilitate the next process [15]. We apply this text preprocessing to the question data submitted by the user. Here are some of the techniques we use.

a. Case Folding: Converts all letters to lowercase and removes punctuation.
b. Stopword Removal: a technique to remove words that have little meaning in a sentence.
c. Tokenization: a technique for cutting sentences into words [17], [18].
d. Post Tagging: the technique of tagging words according to the type of word [7].

3. RESULT AND DISCUSSION

3.1 Ontology

The ontology is built based on information about the history of the Sumedang Larang Kingdom that has been collected. Figure 2 shows the ontology design that has been built. This ontology consists of 5 main classes, namely “sejarah”(history), “tentang” (about), “tempat_pemerintahan” (place_government), “peninggalan” (relic), dan “tokoh”(person). The “tokoh” (person) has 2 subclasses namely "kandage" and "raja"(king).

Class “sejarah” (history) contains individuals who contain an event that was experienced by the Sumedang Larang Kingdom, for example, the event that the Sumedang Larang Kingdom became the successor of the Pajajaran Kingdom. Then class “tentang” (about) contains information about the Sumedang Larang Kingdom, for example, information about where the relics of the Sumedang Larang Kingdom are stored, the origin of the name the Sumedang Larang Kingdom, and so on. For class “tempat_pemerintahan” (place_government) filled with individuals from places of government of the Sumedang Larang Kingdom, for example, in the past, the Sumedang Larang Kingdom had its capital in Ciguling, Cipameungpeuk, and Kutamaya. Then class “peninggalan” (relics) contains individuals from the relics of the figures of the Sumedang Forbidden Kingdom. The last one is the class for “tokoh” (person), class “tokoh”(person) has subclass “raja” (king) and “kandage”. The difference between this class and subclass is, for class “tokoh” (person) filled with individuals from figures who do not serve as kings and are not part of Kandage Lante but still play a role in the history of the Sumedang Larang Kingdom, subclass “raja” (king) reserved for individuals who have served as kings and the "kandage" subclass contains individuals who are members of the Kandage Lante group.

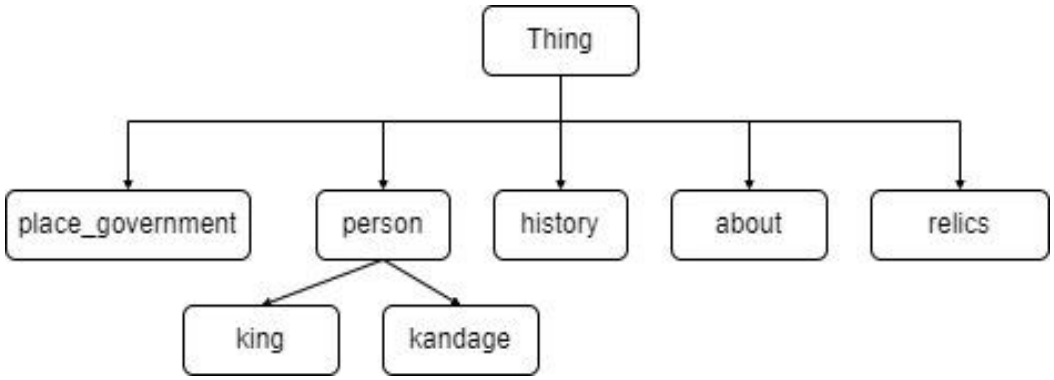

Figure 2. Ontology Design

Each individual in the ontology has data properties, such as name, details, and so on, according to the needs of each individual. However, each individual is required to have at least one data property named “kata kunci” (keyword) because this property data is used to identify the individual during the answer search process. Individuals can also own object properties. Object property is a relationship that connects individuals. For example, the individual "Prabu Geusan Ulun" has a relationship with the individual "Ratu Harisbaya" as husband and wife. So "Prabu Geusan Ulun" has a property object "punya_istri" (have_wife) to "Ratu Harisbaya", while "Ratu Harisbaya" has a property object "punya_suami" (have_husband) to "Prabu Geusan Ulun".

3.2 Text Preprocessing

Text Preprocessing is the process of changing text to prepare text so that it can be processed to the next stage. The processes in this stage include Case Folding, Stopword Removal, Tokenization, and Post Tagging. This process is carried out on the questions asked by the user.

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Figure 3. Text Preprocessing Process Diagram

The following is an explanation of the processes in Text Preprocessing.

a. Case Folding: Questions are carried out by the Case Folding process, namely changing all letters in sentences to lowercase and removing punctuation marks. Table 1 shows the results of the Stemming stage.

Table 1. Case Folding Results

Before Case Folding	After Case Folding
Siapa nama RAJA KEdelapan di kerajaan Sumedang Larang?? (What is the name of the EIghth KING in the Sumedang Larang kingdom??)	siapa nama raja kedelapan di kerajaan sumedang larang (what is the name of the eighth king in the kingdom of sumedang larang)
Mengapa Kerajaan Sumedang Larang berada dibawah kekuasaan Kerajaan Pajajaran pada masa Ratu Istri Rajamantri?! (Why was the Sumedang Larang Kingdom under the control of the Pajajaran Kingdom during the Ratu Istri Rajamantri?!)	mengapa kerajaan sumedang larang berada dibawah kekuasaan kerajaan pajajaran pada masa ratu istri rajamantri (why was the sumedang larang kingdom under the control of the pajajaran kingdom during the ratu istri rajamantri)
Nama Dari ANAK Raja Prabu Geusan ULUN, siapa? (What is the name of the son of King Prabu Geusan ULUN?)	nama dari anak raja prabu geusan ulun siapa (what is the name of the son of king prabu geusan ulun?)

b. Stopword Removal: This process removes words that have little meaning in a sentence [17]. Here we use the Sastrawi library. However, because the words ‘setelah’ (after), ‘telah’(has), ‘sebelum’(before), ‘belum’(not yet), ‘kedua’(second), ‘dua’(two), ‘mengapa’(why), ‘dimana’(where), enter the Stopword in Sastrawi while the words are important in this system, then a slight change is made in the stopword list. Table 2 show the result of Stopword Removal.

Table 2. Stopword Removal Results

Before Stopword Removal	After Stopword Removal
siapa nama raja kedelapan di kerajaan sumedang larang (what is the name of the eighth king in the kingdom of sumedang larang)	siapa nama raja kedelapan kerajaan sumedang larang (what name king eighth kingdom sumedang larang)
mengapa kerajaan sumedang larang berada dibawah kekuasaan kerajaan pajajaran pada masa ratu istri rajamantri (why was the sumedang larang kingdom under the control of the pajajaran kingdom during the ratu istri rajamantri)	mengapa kerajaan sumedang larang berada dibawah kekuasaan kerajaan pajajaran masa ratu istri rajamantri (why sumedang larang kingdom under control pajajaran kingdom during ratu istri rajamantri)
nama dari anak raja prabu geusan ulun siapa (what is the name of the son of king prabu geusan ulun?)	nama anak raja prabu geusan ulun siapa (what name son king prabu geusan ulun)

c. Tokenization: Tokenization is the process of breaking sentences into words or tokens [17]. An example of the tokenization results can be seen in Table 3.

Table 3. Tokenization Results

Before Tokenization	After Tokenization
siapa nama raja kedelapan kerajaan sumedang larang (what name king eighth kingdom sumedang larang)	['siapa', 'nama', 'raja', 'kedelapan', 'kerajaan', 'sumedang', 'larang'] (['who', 'name', 'king', 'eighth', 'kingdom', 'sumedang', 'larang'])
mengapa kerajaan sumedang larang berada dibawah kekuasaan kerajaan pajajaran masa ratu istri rajamantri (why sumedang larang kingdom under control pajajaran kingdom during ratu istri rajamantri)	['mengapa', 'kerajaan', 'sumedang', 'larang', 'berada', 'dibawah', 'kekuasaan', 'kerajaan', 'pajajaran', 'masa', 'ratu','istri', 'rajamantri'] (‘why’, ‘sumedang’, ‘larang’, ‘kingdom’, ‘under’, ‘control’, ‘pajajaran’, ‘kingdom’, ‘during’, ‘ratu’, ‘istri’, ‘rajamantri’)

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nama anak raja prabu geusan ulun siapa (what name son king prabu geusan ulun)	['nama', 'anak', 'raja', 'prabu', 'geusan', 'ulun', 'siapa'] (‘what’, ‘name’, ‘son’, ‘king’, ‘prabu’, ‘geusan’, ‘ulun’)

d. POS Tagging: POS Tagging is the process of tagging/grouping words based on the type of word. The POS Tagging used is the result of the POS Tagging design from [19]. However, the tag set needs to be changed because the results of the Tagging Post with the historical domain of the Sumedang Larang Kingdom are not so good. This change is made by creating manual tags for words that are considered important.

Table 4 shows some tags done manually. The “word” column contains the word resulting from tokenization, then the “tag” column is the tag assigned to that word. Table 5 Shows the difference between tags before and after adjustments. This adjustment was made to simplify the word identification process which was carried out at a later stage.

Table 4. Manual Tag List Sample

word	tag
Siapa (who)	WH
ulun	NN
Delapan (eight)	OD

Table 5. Tag Results Comparison

Before POS Tagging	POS Tagging Results	POS Tagging Results (Tags have been adjusted)
['siapa', 'nama', 'raja', 'kedelapan', 'kerajaan', 'sumedang', 'larang'] (['who', 'name', 'king', 'eighth', 'kingdom', 'sumedang', 'larang'])	[[('siapa', 'CD'), ('nama', 'NN'), ('raja', 'NN'), ('kedelapan', 'NN'), ('kerajaan', 'NN'), ('sumedang', 'NN'), ('larang', 'NN')]]	[['siapa', 'CD'], ['nama', 'NN'], ['raja', 'NN'], ['kedelapan', 'NN'], ['kerajaan', 'NN'], ['sumedang', 'NNP'], ['larang', 'NNP']]
['mengapa', 'kerajaan', 'sumedang', 'larang', 'berada', 'dibawah', 'kekuasaan', 'kerajaan', 'pajajaran', 'masa', 'ratu','istri', 'rajamantri'] (‘why’, ‘sumedang’, ‘larang’, ‘kingdom’, ‘under’, ‘control’, ‘pajajaran’, ‘kingdom’, ‘during’, ‘ratu’, ‘istri’, ‘rajamantri’)	[[('mengapa', 'WH'), ('kerajaan', 'NN'), ('sumedang', 'NN'), ('larang', 'NN'), ('berada', 'VB'), ('dibawah', 'NN'), ('kekuasaan', 'NN'), ('kerajaan', 'NN'), ('pajajaran', 'NN'), ('masa', 'NN'), ('ratu', 'CD'), ('istri', 'NN'), ('rajamantri', 'NN')]]	[['mengapa', 'WH'], ['kerajaan', 'NN'], ['sumedang', 'NNP'], ['larang', 'NNP'], ['berada', 'VB'], ['dibawah', 'NN'], ['kekuasaan', 'NN'], ['kerajaan', 'NN'], ['pajajaran', 'NNP'], ['masa', 'NN'], ['ratu', 'NN'], ['istri', 'NN'], ['rajamantri', 'NN']]
['nama', 'anak', 'raja', 'prabu', 'geusan', 'ulun', 'siapa'] (‘what’, ‘name’, ‘son’, ‘king’, ‘prabu’, ‘geusan’, ‘ulun’)	[[('nama', 'NN'), ('anak', 'NN'), ('raja', 'NN'), ('prabu', 'NN'), ('geusan', 'NN'), ('ulun', 'VB'), ('siapa', 'WH')]]	[['nama', 'NN'], ['anak', 'NN'], ['raja', 'NN'], ['prabu', 'NN'], ['geusan', 'NN'], ['ulun', 'NN'], ['siapa', 'WH']]

3.3 Word Identification

The results of the Text Preprocessing stage are words that have been tagged. Word identification will be done by grouping words into three groups, namely Keyword Identification, Property Word Identification, and Object Word Identification.

a. Keyword Identification: Words with NN, OD, CD, and NNP tags will be added to the Keyword Potential list. The word in the list is permuted, and the results are matched with the list of "list_katakunci" (list_keyword) obtained from the property data "kata_kunci" (key_word) in the ontology. If a match is found, the word is stored in the “kata_kunci” (key_word) list.
b. Object Word Identification: The list of tag words from the Text Preprocessing results will be seen if they are in the object word list. If there is, then the word is included in the “kata_objek” (object_word) list. The object word

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list can be seen at Table 6. The list is used to associate tagged words with words used to search for objects in the ontology.

Table 6. Object Word List Sample

word	objectproperty
anak (child)	punya_anak (have_child)
ayah (father)	punya_ayah (have_father_
ibu (mother)	punya_ibu (have_mother)
istri (wife)	punya_istri (have_wife)
saudara (sibling)	punya_saudara (have_sibling)
suami (husband)	punya_suami (have_husband)
setelah (after)	setelah (after)

c. Identification of Property Words: The list of tag words from the Text Preprocessing results will be seen if they are in the "list_property" list. If there is, then the word is included in the “kata_property” (word_property) list. The “list_property” list can be seen in Table 7. The list is used to associate the tagged words with the words used to search property data in the ontology. If the question does not identify any property words, it will be automatically entered "nama"(name) as the data property in question.

Table 7. Property Word List Sample

word	dataproperty
siapa (who)	nama (name)
nama (name)	nama (name)
gelar (title)	gelar (title)
apa (what)	detail (details)
apa (what)	nama (name)
dimana (where)	lokasi_sekarang (current location)
mana (where)	lokasi_sekarang (current location)

3.4 Building a SPARQL Query

The identified words are entered into the pre-designed query syntax. This syntax has its differences, each according to the results of the word identification that has been done. Syntax of Figure 4 used when the keyword is only one and the word object is not found. Syntax of Figure 5 used if the keyword is one and the word object is found. Syntax of Figure 6 used if the keyword is more than 1 and the word object is not found. Syntax of Figure 7 used if the keyword is more than 1 and the word object is found. Then the last one Figure 8, used when the keyword is not found, here it is assumed that the answer requested is a list. For example, asked for the names of kings or the names of relics.

```
SELECT *
WHERE {
?individu           rdf:type            owl:NamedIndividual .
?individu           ?properti           ?info .
?individu           table:kata_kunci    ?kata_kunci .
?properti           a                   owl:DatatypeProperty .
FILTER(STR(?kata_kunci)= '"""+katakunci+"""')
FILTER(STR(?properti)= 'http://www.semanticweb.org/asus/ontologies/2022/3/sumedanglarang#"""+kataproperti+"""')
}
```

Figure 4. SPARQL query for one keyword and property word

```
SELECT *
WHERE {
?individu           rdf:type                            owl:NamedIndividual .
?individu           ?object                             ?info .
?individu           table:kata_kunci                    ?kata_kunci .
?object             a                                   owl:ObjectProperty .
?info               table:"""+kataproperti+"""          ?atribut .
FILTER(STR(?kata_kunci)= '"""+katakunci+"""')
FILTER(STR(?object)= 'http://www.semanticweb.org/asus/ontologies/2022/3/sumedanglarang#"""+kataobjek+"""')
}
```

Figure 5. SPARQL query for single keyword, property word, and object word

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```
SELECT DISTINCT *
WHERE {
?individu           ?predikat                          ?individu_2 .
?individu           table:kata_kunci                   ?kata_kunci .
?individu_2         table:kata_kunci                   ?kata_kunci_2 .
?individu_2         table:"""+kataproperti+"""         ?properti .
FILTER(STR(?kata_kunci) = """+katakunci_1+""") .
FILTER(STR(?kata_kunci_2) =  """+katakunci_2+""")
```

Figure 6. SPARQL query for two keywords and a property word

```
SELECT DISTINCT *
WHERE {
?individu           ?predikat                          ?individu_2 .
?individu           table:kata_kunci                   ?kata_kunci .
?individu_2         table:kata_kunci                   ?kata_kunci_2 .
?individu_2         table:"""+kataproperti+"""         ?properti .
FILTER(STR(?kata_kunci) = """+katakunci_1+""") .
FILTER(STR(?kata_kunci_2) =  """+katakunci_2+""") .
FILTER(STR(?predikat)= 'http://www.semanticweb.org/asus/ontologies/2022/3/sumedanglarang#"""+kataobjek+""")
}
```

Figure 7. SPARQL query for two keywords, property word and object word

```
SELECT *
WHERE {
?subjek             rdf:type                           table:"""+kata+""" .
?subjek             table:"""+kataproperti+"""         ?objek .
}
```

Figure 8. SPARQL query for two keywords, property word and object word

3.5 Evaluation

We conducted a system accuracy test with 100 questions. This evaluation is done by preparing the questions and expected answers, then the answers from the system are compared with the expected answers.

Table 8 is a sample of the results of the test. The calculation of the system accuracy test is carried out by implementing the formula $\boldsymbol{accuracy}=\frac{\boldsymbol{correct\ answer}}{\boldsymbol{total\ questions}}\ \boldsymbol{x}\ \mathbf{100\%}$ (**1**)

$$\boldsymbol{accuracy} = \frac{\boldsymbol{correct\ answer}}{\boldsymbol{total\ questions}}\ \boldsymbol{x}\ \mathbf{100\%} \qquad (1)$$

The results of the system correctness test are 13 questions that produce incorrect answers and 87 questions are answered correctly. Then the accuracy obtained is 87%. The calculation results can be seen in $\boldsymbol{accuracy}=\frac{\mathbf{87}}{\mathbf{100}}\ \boldsymbol{x}\ \mathbf{100\%} = \mathbf{87\%}$ (**2**). Questions regarding the name of the character, the answer will automatically attach another name/title of the character if there is one. This is done because the name of the king is often more familiar with the name of his title.

$$\boldsymbol{accuracy} = \frac{\mathbf{87}}{\mathbf{100}}\ \boldsymbol{x}\ \mathbf{100\%} = \mathbf{87\%} \qquad (2)$$

Table 8. System Accuracy Test Results

Questions	Expected Answer	Answer test results	Suitability
Siapa nama lain Batara Tuntang Buana? (What is the other name of Batara Tuntang Buana?)	Prabu Resi Tajimalela	Batara Tuntang Buana punya nama lain/gelar Prabu Resi Tajimalela (Batara Tuntang Buana has another name / title Prabu Resi Tajimalela)	suitable
siapa nama anak Prabu Geusan Ulun dari istri pertama? (what is the name of Prabu	Pangeran Rangga Gede	Pangeran Rangga Gede, Nyi Mas Cukang Gedengwaru	inaccurate

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Geusan Ulun's son from his first wife?)			
Nama raja-raja di sumedang larang (The names of the kings in Sumedang Larang)	Raden Angkawijaya punya nama lain/gelar Prabu Geusan Ulun, Batara Tuntang Buana punya nama lain/gelar Prabu Resi Tajimalela, Raden Aria Suriadiwangsa punya nama lain/gelar Raden Suriadiwangsa, Nyimas Ratu Dewi Inten Dewata punya nama lain/gelar Ratu Pucuk Umun, Wirajaya punya nama lain/gelar Sunan Pagulingan, Prabu Tirtakusuma punya nama lain/gelar Sunan Patuakan (Raden Angkawijaya has another name/the title of Prabu Geusan Ulun, Batara Tuntang Buana has another name / the title of King Resi Tajimalela, Raden Aria Suriadiwangsa has another name / the title Raden Suriadiwangsa, Nyimas Ratu Dewi Inten Dewata has another name / the title Ratu Pucuk Umun, Wirajaya has another name/title Sunan Pagulingan, Prabu Tirtakusuma has another name/title Sunan Patuakan)	Nyimas Ratu Patuakan, Prabu Gajah Agung, Raden Angkawijaya punya nama lain/gelar Prabu Geusan Ulun, Batara Tuntang Buana punya nama lain/gelar Prabu Resi Tajimalela, Raden Aria Suriadiwangsa punya nama lain/gelar Raden Suriadiwangsa, Nyimas Ratu Dewi Inten Dewata punya nama lain/gelar Ratu Pucuk Umun, Ratu Istri Rajamantri, Sunan Guling, Wirajaya punya nama lain/gelar Sunan Pagulingan, Prabu Tirtakusuma punya nama lain/gelar Sunan Patuakan (Nyimas Ratu Patuakan, Prabu Gajah Agung, Raden Angkawijaya have another name/the title is Prabu Geusan Ulun, Batara Tuntang Buana has another name/the title is Prabu Resi Tajimalela, Raden Aria Suriadiwangsa has another name/the title is Raden Suriadiwangsa, Nyimas Ratu Dewi Inten Dewata has another name /the titles of Ratu Pucuk Umun, Ratu Wife Rajamantri, Sunan Guling, Wirajaya have another name/the title of Sunan Pagulingan, Prabu Tirtakusuma has another name/the title of Sunan Patuakan)	suitable
Apa saja peninggalan kerajaan sumedang? (What are the relics of the Sumedang kingdom?)	Badik Curuk Aul, Keris Ki Dukun, Keris Panunggul Naga, Mahkota Binokasih, Pedang Ki Mastak	Badik Curuk Aul, Keris Ki Dukun, Keris Panunggul Naga, Mahkota Binokasih, Pedang Ki Mastak, Mahkota Binokasih adalah mahkota Kerajaan Pajajaran yang diberikan kepada Prabu Geusan Ulun sebagai tanda bahwa Kerajaan Sumedang Larang sebagai penerus Kerajaan Pajajaran (Badik Curuk Aul, Keris Ki Shaman, Keris Panunggul Naga, Crown Binokasih, Sword Ki Mastak, Crown Binokasih is the crown of the Kingdom of Pajajaran given to Prabu Geusan Ulun as a sign that the Kingdom of Sumedang Larang is the successor of the Kingdom of Pajajaran)	inaccurate

Test results with inaccurate answers are questions with results that have more than 1 answer but one of the answers is correct. This can happen because, first, if there are more than 1 keyword and more than 1 object word and all relations of object words are contained in the ontology. For example, the question “siapa nama anak Prabu Geusan Ulun dari istri pertama?” ("what is the name of Prabu Geusan Ulun's son from his first wife?") identified the keywords ['istri pertama', 'anak istri pertama', 'prabu geusan ulun'] (['first wife', 'first wife's child', 'prabu geusan ulun']) and also identified the object word ['punya_anak', 'punya_istri'] (['have_child', 'have_wife']) then based on the system it was found that “prabu geusan ulun” has the relation “punya_anak” (have_child) with “anak istri pertama” (first wife's children) and also has a “punya_istri” (have_wife) with “istri pertama” (first_wife). So the answer that appears there are 2 answers.

Then the second, in the question identified more than 1 property word and the data is contained in the ontology. For example in the question “Apa saja peninggalan kerajaan sumedang?” ("What are the relics of the Sumedang kingdom?") the word “Apa” (what) is identified as a property word for "nama" (name) and "detail" (details) so that the answers given are “Badik Curuk Aul, Keris Ki Dukun, Keris Panunggul Naga, Mahkota Binokasih, Pedang Ki Mastak” for the results of the property data "nama" (name) and for "detail"(details) were answered “Mahkota

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Binokasih adalah mahkota Kerajaan Pajajaran yang diberikan kepada Prabu Geusan Ulun sebagai tanda bahwa Kerajaan Sumedang Larang sebagai penerus Kerajaan Pajajaran" ("The Crown of Binokasih is the crown of the Kingdom of Pajajaran which was given to Prabu Geusan Ulun as a sign that the Kingdom of Sumedang Larang is the successor of the Kingdom of Pajajaran").

4. CONCLUSION

Based on the results of our research, it can be concluded that in QAS to process incoming questions, it is necessary to understand the purpose of the questions well. This can be done by maximizing text preprocessing and word identification. The stopword removal process also needs adjustments when it is implemented in a domain. The use of ontology for knowledge representation also needs to be built properly so that it can be used optimally. The results of the built QAS performance can be said to be good because based on testing many questions the answers are correct. If the answer is not correct, it still has the correct answer in it. For future research, further research can be carried out such as adding information on the Sumedang Larang Kingdom during the district and other heritage information in the ontology. Optimizing the text processing process so that errors that occur in this study can be resolved, as well as adding a list of words to the property and object identification process so that the system can process questions that have a more varied vocabulary.

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