Ontological Modeling and Semantic Search in Quran

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Summary

Muslims believe that the Quran is a sacred book and are words of Allah. Muslims also believe that the Quran provides a complete code of the conduct of spending their lives. That's why they find answers to their questions from the Quran. In the past, many ontology modeling and search work about Quran is performed, which have ignored simultaneous usage of Quran, Hadith, Tafsir ontology modeling and semantic search. In this paper, an ontology is developed considering Quran, Hadith and Tafsir, altogether and then semantic search is performed on Zakat, as a use case, which is one of the main pillars of Islam. Quran has allegorical complex text structure that's why usage of Tafsir and hadith to understand the Quranic concept is always emphasized. Protégé editor is used for Zakat ontology development, employing top-down process consisting of three main steps, which are, data collection, precautions of data collections and development, and Zakat ontology formulation. Furthermore, Zakat ontology formulation section consists of seven steps, Informal competency questions are formulated with the help of religious scholars for performance evaluation. SPARQL query language is used for querying and results of competency questions show that proposed approach complies with competency questions.

Keywords:
Ontology Modeling, Semantic Search, Protégé, SPARQL, Quran, Zakat

1. Introduction

From Ontology development is a process to gather a knowledge of a specific domain. Ontologies allow the user to inquire different queries and get refined results. It helps the users to get information of a specific domain without going to a pool of relevant and irrelevant information. Developing ontologies has always been the topic of interest for researchers. Different types of ontologies are developed e.g., Fuzzy ontologies, information security, historical ontologies, and biomedical ontologies [1-4].

Recently, researchers also focused on developing ontologies related to the religions. A class of ontology deals with Muslim religion is known as Islamic ontology. Islamic ontology is further classified into many domains, such as, Quran ontology, hadith ontology and tafsir ontology, etc. Quran is a complete book for believers of Islam. It deals with every aspect of life ranging from life to death and even after death. Muslim believes that extracting knowledge only from Quran is not enough, so that they may need to also read about hadith and tafsir. Some contributions in developing ontologies related to five pillars of Islam are made in the past. Importance of obligation of five pillars of Islam e.g., Shahadah, Prayer, Fasting, Zakat, and Hajj are highlighted many times in the Quran. It is important to gather knowledge of all orders especially related to these five pillars of Islam. Mostly, researchers focus on developing ontologies of five pillars of Islam by not considering Quran, Hadith and Tafsir, altogether. However, Quran, hadith and tafsir is a huge pool of knowledge and extracting data from them altogether for developing and ontology is important.

Quran ontology is developed by employing different approaches. In these approaches different tools are used, e.g., Natural language processing (NLP), Apache Jena and protégé are noteworthy. NLP tool is HCI (human computer interface), which deals with the interaction of natural languages and their interaction with the computer. Some ontologies are developed by using Apache Jena tool, which is a semantic web tool. It provides an API to retrieve data and write in the form of Resource Description Framework (RDF) [5-7]. Another popular tool used for ontology development is Protégé. This open access free tool is the most used tool by researchers for ontology development. It also supports the Description Logic (DL), SPARQL plugin which is used for the ontology evaluation. Different ontologies e.g., animals, Quran, nature related, and Q nature are presented using protégé [8-11].

Keywords and Semantics-based search is applied in ontology as well. Keyword search-based ontologies are the one, in which user enters a keyword and the word is then matched in the ontology. Results are displayed when the query is exactly matched. Keyword search is not always accurate because of erroneous results produced in mismatch scenario, where exact match is not available. An approach for improved extraction of relevant verses through concepts and keyword search is proposed, which increase the accuracy of search results [12]. Other keywords-based studies are also used for search in ontologies [13-16]. Semantic search tool is widely used in Quran ontologies due to its contextual abilities [17].

Salat ontology is also developed, which provides semantic search results from the data set of Quran. Quran

provides all concepts and orders related to salat but still there are situations, which are well explained in hadith and tafsir [18]. Keyword search and protégé tool based salat ontology provides the exact match results for user queries. This search tool is only sufficient for the case of verse extraction in which word salah is used [19, 20]. Some studies focused on the third pillar of Islam, which is fasting. These ontologies are developed on data set of Quran and Quran with tafsir [21, 22].

Zakat is the fourth pillar of Islam, and its importance cannot be denied. For economic balancing in society zakat plays an important role. It is a beautiful way of sharing assets with needy people in the society. Infect zakat is a balance bridge of the economy. Quran, hadith and tafsir may provide solution of every query related to zakat and other pillars of Islam. Unfortunately, zakat ontology is not investigated so far in the literature.

In the light of existing research, it is found that there should be an ontology related to zakat, which should provide detailed information and concepts by using Quran, hadith and tafsir altogether. In this paper, work is done in three phases: data collection, precaution during the data collection and ontology development, and Zakat ontology formulation. In the data collection phase, a religious book published by Darussalam is chosen, which is a well-known piece of literature in this perspective. In the second phase, help from religious scholars is sought, because of the sensitivity of the topic. According to their guidance, data collection process is performed. The third phase is Zakat ontology formulation, in which SPARQL query language is used for performance evaluation. The results show that proposed approach is more intuitive as compared to the existing Quran ontologies.

Major contributions of this research work are as follows:

- Zakat Ontology development which is not investigated in the literature.
- Large data set is used, which provides a detailed semantic search on Quran, hadith and tafsir, simultaneously. Using this ontology one can find all the concepts of zakat in the light of Quran, hadith and tafsir.
- This ontology is useful in modern Islamic banking for zakat evaluation process.
- Experimental validation by applying competency queries and scholar's verification of presented zakat ontology on large data set.

Paper is organized in a way, section I provides introduction and contribution of this work. Section II discuss the literature review of Islamic ontologies. Section III and IV are the problem formulation and methodology of zakat ontology. Experimental results and complete comparison of proposed method with others is presented in Section V. Conclusion is provided in section VI.

2. Related Work

Different types of ontologies are presented in literature. Islamic ontologies are the focus of Islamic computing scholars. Three different tools, such as, NLP, Apache Jena and Protege are usually employed for ontology modeling in the literature. In Addition to aforementioned tools, few efforts have been made on data usage e.g. public data and private data [23]. With datasets and tools, researchers used two types of search techniques for ontology validation, which are, keyword-based search and semantics-based search.

2.1 Quran Ontology

Islamic knowledge is based on Quran so, Quran ontology plays an important role in searching or gathering knowledge from Quran. In the literature, ontologies related to Quran are Prophet's ontology, Salat Ontology, Fasting ontology, Animal's ontology, and Arabian language ontologies [5-11].

Quran knowledge ontology is developed by Harrag et al. Presented ontology extract main terms, performs stop word removal and stemming, weighting and relation is also retrieved through concepts. Data set used for this ontology is only those chapters of Quran which are related to prophets. They used Apriori algorithm for association rules and NLP tools. In addition to NLP, association rules are used, and manual comparison is also presented [24].

Modified prophets' ontology was presented by Al-Sanasleh & Hammo [25]. They developed ontology of 27 prophets using Protégé. Data sets used are only Quran and Hadith. They integrate the knowledge of prophet's lives, teachings and books in the light of Quran and Hadith. Results are verified with the help of questions verification from the Islamic scholars [25]. Automatic retrieved semantic relation model is proposed by Al-Zamil & Al-Radaideh [26]. Data sets used for this model were Quran, Arabic newspapers, and blogs. Classical Arabic language, NLP and enhanced version of Hearst algorithm is used in this research.

A classifier is designed, which accepts Arabic text, analyze and extract relations. Positive and negative patterns are presented for correct and incorrect information, respectively. Precision, Recall and F-measure for this research reported were 78.5, 80.71% and 79.54% [26], respectively. Classical Arabic data set based Quran ontology has been presented by Alqahtani & Atwell [27]. Their goal was to develop Arabic Quranic Semantic search tool. Presented ontology explores concepts, phrases, topics, questions, and sentences from the data set. Keyword search tools were used for comparison. This research was on Classical Arabic language which is different from modern Arabic language. Classical Arabic language and Quran are the limitations of this work [27].

Duke also worked on classical Arabic language-based ontology [28]. Focus of this research was comparison between pure dependency parser and integrated parsing model. Data set used for this research was Quran only. Using NLP tool, he explored that pure dependency is more accurate. For Pure dependency and Integrated Parsing, F1-Score of Duke's research were 87.47% and 89.03%, respectively [28]. Hybrid combination of Protégé, OWL, Jena TDB with Fuseki server was presented on the data set of semantic Quran and Quran Arabic Corpus QAC ontology by Hakkoum & Raghay [5].

They proposed advance search tool based on stemming and synonyms generation. Focus of this research was to provide advanced search tools. They explored that pronoun and tafsir gave more accurate results than word and root searching only [5]. English, French, Arabic, German, and Russian language-based data set is developed by Sherif & Ngomo [6]. Apache jena is used and Resource description format (RDF) is developed. They provide link to support with other languages by DBPedia and Wiktionary. Data sets used for this research are Tanzil project and QAC. Precision reported for English, French, and German was 100%, 96% and 87%, respectively [6].

Semantic search engine is presented by hybrid search tools e.g. Protégé and Jena TDB. Manual Queries are developed by scholars and validated on the presented model. Precision and Recall were 95% and 73%, respectively. But limited concepts from Quran is used for data set [7]. Animal ontology on data set of Quran was proposed by H. U. Khan [8]. Proposed ontology provided direct and indirect references of animals and birds in Quran. This research also provided user interface for question and results [8]. User query based semantic research were proposed in the literature. Results were displayed on the base of Quran and historical concepts [9, 29].

Nature related concepts in Quran was also proposed by researchers. Proposed ontology results verse number using SPARQL [10]. Deficiency in nature related ontology was fulfilled by QNature ontology [11]. QNature ontology was user-friendly ontology, as it provided answers in the form of natural language [11]. Keywords-based search approach was proposed by Noordin, which give results only when query was exactly match. During the design of a system, researchers survey 125 websites and seek knowledge from Hadith as well. Main objective of this data set was to improve the search efficiency of the system. Unfortunately, they did not retrieve the many relevant verses [13]. Main drawback of this research was irrelevant search results. Another synonym-based research was proposed [12]. They explored that Synonym-based search is more accurate than keyword-based and stem-based. Data set used for this research is Quran. Keyword search base this research has precision for synonyms was 0.92%, Text-based 0.80% and stem-based was 0.77%.

Quranic authentication-based research was developed by Alshareef & ElSaddik [14]. This research was not user-friendly because users are bound to enter complete or partial sentence and this approach did not provide subject base results [14]. Another keyword search-based approach was proposed, which provides all data related to entered query [15]. Collective spatial keyword query (CoSKQ) was used for keyword matching. From literature, it was found that exact keyword matching approaches are presented. These approaches have failed, when user enter wrong spellings e.g., color vs colour. Zhe Feng [30] developed keyword search approach which resolved the spelling error issues and time-based queries.

Taxonomy related semantic search in the Quran was proposed by Shoaib et al. [17] Proposed research was limited to Surah Al-Bakrah only. Abdel Nasser et al developed a semantic search on Quran ontology. The system has provided semantic search from the Quran ontology by using different relationship and constraints. The system also provided user interface for entering query and getting output. Ontology assisted semantic search system did not support to reformulate the user query according to data set. Sometime the user decided to search for knowledge through Questions, so the proposed program did not help such searches. Semantic relation with Quranic words research was proposed [31]. Aim of authors were to provide a framework with good retrieval accuracy using dependency relations. Developed research is validated by prototype Q/A system by comparing actual answers and retrieved answers. This research provided results related to Quran [31].

Another semantic search-based approach was presented in literature which provides hybrid combination of semantics and co-occurrence of words [32]. In 2020, Ensaf Hussain presented semantic search-based research [33]. Concept-based searching tool Quran semantic search tool (QSST) was designed for the Quran. Data set of Quranic verses was generated manually with the aid of Mushaf Al-Tajweed ontology. Ensaf trained the Continuous Bag of Words (CBOW) and calculated the feature vectors. Presented feature vector which justify both the input query and topics related to the Quran. Results were compared with Mushaf Al-Tajweed and Islamic experts' opinions, with 91.95% precision. Like other researches, it is also domain specific [33].

Semantic-based query expansion technique was developed by Nuhu Yusuf [34]. Query expansion technique was presented with hybrid combination of semantic search and Lucene ranking. Nuhu used the semantic search of query and after that, this query was expanded by synonyms of word. A novel relationship was developed between expanded query and concepts of Quan. For results improvement modified Lucene ranking algorithm was presented. Data sets for this research have been extracted from Tanzil website. Proposed research

was validated on 8 data sets [34]. Novel periodic learning ontology matching based on grasshopper optimization algorithm was presented in [4]. This research resolved the issues in ontology matching related to user involvement in real life applications.

2.2 Salat Ontology

Salat ontology was presented on the data set of English Translated Quran. For ontology development, Hybrid combination of semantic technology and natural language processing is presented by Saidah Saad [35]. Presented ontology generated new pattern and extracted information only from the Quran. Results were validated by comparison with existing method [35]. Salat related ontology was developed on the data set developed from Quran. This ontology was also domain specific and presents results from Quran data set only. Semantic search engine was also developed for users [18].

N. Islam, K. Laeeq, J. Sheikh also addressed salat ontology [19]. They developed search engine for salat which provide answers. Keyword-based salat ontology was developed on protégé. They established search cases for validation. Advancement in Salat ontology was presented by Speech recognition feature. Three different phases of this research were, development of light weight Quran ontology, training, and testing [20]. N. Islam, K. Laeeq, J. Sheikh also addressed salat ontology. They developed search engine for salat, which provided answers to user queries. Keyword-based salat ontology was developed on protégé. They established search cases for validation.

2.3 Fasting Ontology

Hamed & Aziz proposed a Question Answer framework that included semantic search for surah al-Baqrah regarding fasting, pilgrimage fasting and pilgrimage [21]. They used a classifier that had categorized certain verses relevant to pilgrimage and fasting. Question answering program has only been conducted on Surah al-Bakrah and framework has not been supported, if the user decided to search through concepts, phrases, topics, questions, and sentences.

Another modified fasting ontology is presented by Zailani et al. [22]. Data set used for this ontology was Quran and tafseer only, which covers more concepts than the existing work by Hamed & Aziz. O. Zailani et al. [22] used Protégé tool for fasting ontology. Presented ontology highlighted the fasting concepts from Quran and tafseer and did not cover Hadith.

3. Problem Formulation

If Ontologies related to Quran and pillars of Islam are presented in literature did not aid Zakat ontology. Ontologies presented are not fruitful for Zakat ontology as they are developed for limited specific data sets. They provide results only related to specific domain e.g., animals related ontology provides search results only when you search animals. If a user wants to search Zakat related concept or data, no ontology or search system is available.

3.1 Problem statement

Islamic ontologies presented in the literature are highly domain specific. There is a dire need to investigate ontologies related to five pillars of Islam due to their high importance and specificity. Most of the literature addresses the ontologies related to Salat in Quran, only [19, 35]. Fasting ontology is also investigated a bit in the literature [22]. Zakat is the mainspring in social protection system in Muslim society. It provides a relief to needy. Zakat is efficiently described in Quran, hadith and tafsir. Unfortunately, scholars did not pay attention for developing Zakat ontology. Conclusively, semantic search approach related to Zakat ontology, which may provide a detailed information related to Zakat in the light of Quran, hadith and tafsir in parallel is missing.

3.2 Problem Setting

For ontology development, mathematical representation of problem statement is defined here. First, thing one must do is, to define a data set or range for which ontology is developed. Consider a set D = {set of all information related to Quran, hadith and tafsir}. For this data set a book is studied [36]. Then set of classes of Zakat is defined. Universal data set for classes is defined as Z, which consists of set of all classes, which is proposed in Zakat ontology development. $Z=\{C_i\}$. Where, C belongs to the classes and $i=\{0, ++1,7\}$. Every element in set, Z are also subset e.g., c_1 is the subset of C_1. Similarly, other classes are also divided into subsets. So, when query is raised it is searched in set Z which define the exact domain. After this, process of knowledge gathering related to query is followed. If the results are not found than null result is received. R is defined as results and Q is defined as query, then

$$R(Q) = (Q \cap Z) \cap D \text{ (1)}$$

4. Zakat Ontology

From Extracting knowledge of Quran is always the super interested topic for Islamic computing researchers. It is the complete book which provides solution of every

aspect of daily life. For applying any search tool and ontology development, knowledge of its division is very important. Firstly, understanding the Juzz division, surah, and verses division is important. In this section, details of the methodology tools, language, and hierarchy of Zakat ontology is presented [20].

Obligation to pay Zakat is very important to keep balance and purification of wealth as per Islam. Zakat concept is very much like the tax system these days implemented in many countries. This fourth pillar of Islam plays a vital role in wealth circulating cycle in the society. Development of Zakat ontology will help for benchmarks of Zakat in business, bank balance and other wealth entities. We developed an ontology which is contextual based and covers whole society issues related to Zakat. It can be used in banks to resolve public queries. Due to its wide data sets it provides results in detail.

4.1 Tool

Protégé is an open access tool which is widely used by researchers. Protégé is java-based tool which provides Graphical User Interface (GUI) and plug in facility. In addition to specification, this tool it also supports Description Logic (DL) and SPARQL plugin. In this research, protégé ontology development tool and SPARQL plugin for ontology evaluation is used. SPARQL is used for querying to Resource Description Framework (RDF), but it is not limited to querying the RDF format only. In related work section, one can see that keyword and semantic search tools are used for query search. Main drawback of keyword search is, it is spelling restricted and gives error in miss-match. That's why semantic search base tool is used here, which provides almost error free and semantically relevant results from Quran, hadith and tafsir.

4.2 Data Set

For ontology development data set is very important. Ontologies presented in the literature have limitations as they either provide search in Quran or in hadith. Some researchers provide ontology model for Quran and tafsir as well. In this work a tri-partite model in which, Quran, hadith and tafsir is explored, simultaneously. As Quran is a scared book of Muslims so data set collection step was crucial because it should be accurate, and one must collect reliable data. A book titled "Zakah according to the Quran and Sunna; a comprehensive study of Zakat in Modern Perspective, has been selected to for data set [36]. For result comparison data set of Quran ontology is used [37]. Another data set is also created for performance measurement. Competency question-based test bench is developed. This data set is informal and created with the aid of scholars in international Islamic university Islamabad [36]. Set of competency question are then

implemented on Zakat ontology. For comparison Quran ontology was used. This ontology was based on NLP. Research results [37] show that Joint dependency consistency Parsing is more accurate than Pure dependency parser, integrated parsing model. The Quran ontology consists of more than 300 key concepts and relationships between these concepts by using predicate logic. Reuse method is followed on this ontology for data retrieval. Following are the competency question used for proposed Zakat ontology validation.

- Who deserves Zakat?
- Was Zakat provision allowed in ancient civilization?
- Was Zakat implemented before the migration of Prophet Muhammad (SAW)?
- What are the conditions of Zakat?
- What are the benefits of Zakat and warning for deniers?

4.3 Ontology Model

Different models are used for ontology modeling e.g., general trajectory domain model, a domain knowledge or semantic model and a temporal domain model. Semantic model and methodology presented by Noy & McGuinnes [38] is used in this work. Following steps are involved in Zakat ontology development [37].

- Defining class hierarchy
- Defining sub classes
- Defining classes properties
- Defining facets of properties
- Defining instances

4.3.1 Classes

Top-down hierarchy is used for ontology development process. At this stage hierarchy started from five pillars of Islam. Then curser is pointed towards domain specific ontology Zakat. Topmost class is named as Pillars_of Islam. This class is the combination of five main classes. From which Zakat class is further investigated. In Quran, hadith and tafsir different occasion and condition are defined for Zakat e.g., who are eligible for Zakat, to whom one can give Zakat, and what are conditions for Zakat so, class Zakat is divided further into seven classes.

4.3.2 Sub Classes

Division of classes is not efficient for highlighting all topics related to Zakat so some of the classes are further divided into sub classes. These sub classes provide more knowledge and constraints related to Zakat e.g., class nisab and madina phase is further divided into other classes. Some classes still need to be classified e.g., nisab because its domain is very large, so we further divide this class. Some equivalent classes are also defined to help in query evaluation.

4.3.3   Properties of Classes

Two different properties are also added in Zakat ontology. These properties aid in query competency. Properties defined in this section are attributes of classes e.g., class makkan_phase has properties conditions, limits and time. Properties of classes used here are categorized on object base and data type base.

4.3.3.1   Object Properties

This type of property is used for the connection of resources. Object property is used for class connection e.g., class makkan phase and madian phase has three object properties.

4.3.3.2   Data type Property

Data type property is used for resource and literal. 27 data type properties in Zakat ontology development are defined here.

4.3.4   Facets and Instances of Properties

Domain and range of properties are defined. Defining domain and range enhances the value type, acceptable feature of object and data type property.

- Domain: Domain identifies that this property can be used only to describe the characteristic of a specific class.
- Range: Range identifies that the possible value of a property can be of the type of a specific class

After facets we have worked on instances for classes, which is the last stage of ontology development. 96 instances for Zakat ontology are defined here. They are individually created and then its type is selected. After type selection, class is selected, and finally property value is selected.

5 Experiments

From After successful development of Zakat ontology. next target was validation. Different methods are used for validation e.g., TF-IDF techniques, precision, recall and competency question method. For Zakat ontology, competency question method is used. These competency questions are then employed on Zakat ontology and Quran ontology, after those results are compared.

5.1 Evaluation Method

For semantic search-based ontology evaluation consultancy of Islamic scholars is mandatory, whose knowledge is used for query development and verification. Query data set is developed with the aid of scholars in international Islamic university Islamabad [36]. Set of competency questions are then implemented on Zakat ontology. Following are the competency questions used for proposed Zakat ontology validation.

- Who deserves Zakat?

- Was Zakat provision allowed in ancient civilization?
- Was Zakat implemented before the migration of Prophet Muhammad (SAW)?
- What are the conditions of Zakat?
- What are the benefits of Zakat and warning for deniers?

5.2 Baseline Approach

Proposed Zakat ontology results are compared with Quran ontology [28]. Research results that Joint dependency consistency Parsing is more accurate than Pure dependency parser and integrated parsing model. The Quran ontology consists of more than 300 key concepts and relationships between these concepts by using predicate logic. This ontology is developed by university of Leeds. For comparison of this ontology, we need to retrieve its data. This ontology is giving results only from Quran. Reuse method is followed on this ontology for data retrieval. It is implemented through API at the Quran data set website. We evaluate modeled ontology results with results derived from Quran ontology. Main goal is to provide correct, and all data related to query. Each question is employed on both ontologies, which shows the results comparison precisely.

5.3 Results and Discussion

Firstly, competency questions are applied to Quran ontology by using NLP tool. Keyword Zakat is used, and it finds all verses related to this keyword. The results are mostly irrelevant and cannot satisfy the competency questions. After that, same competency questions are then employed to proposed ontology. Here, proposed ontology means Zakat ontology in the data set of Quran, hadith and tafsir. Protégé is used as ontology development tool and SPARQL query language is used for query search. Results of queries are generated for Quran and Zakat ontology. We filtered the competency question results on both ontologies based on relevant, irrelevant, and total extractions. Results reveals more accuracy of the proposed research.

5.3.1. Deserving Individuals

Deserving individuals are the one who deserve Zakat. There are 30 verses according to book [36], which have mentioned the deserving people for Zakat. When the deserving individuals search is applied to Quran ontology, it failed to retrieve the required verse because relevant verses do not used word Zakat and all 29 extractions are irrelevant. All the results are irrelevant. When same query is applied to proposed Zakat ontology 16 extraction received in which only 11 are relevant and 5 are irrelevant. These eleven results contain eight candidates, which are defined in verse 9:60 in Quran and three are retrieved from hadith and tafsir. Table 1 and Figure 1 shows that proposed ontology provides more relevant results than

baseline because for query 1 Zakat ontology results with 68% accuracy, while Quran ontology provide 0% relevant results.

5.3.2. Zakat Provision in Ancient Civilization

Second, competency question is about Zakat provision in ancient civilization. When this query is applied to Quran ontology results are 24% accurate, while Zakat ontology results in 100%. Results derived from Quran ontology are less relevant because query 2 belongs to the prophet or the nations' name also. Quran ontology results only Zakat word related search. For the same Query, proposed Zakat ontology provides all relevant results because we define the link between two verses which also highlight the superiority of Zakat ontology on Quran ontology.

5.3.3. Zakat before Migration of Prophet Muhammad (SAW)

For third query, Quran ontology provides only 16% relevant, while proposed ontology is 100% accurate. This competency Question belongs to condition of Zakat before migration. We see that proposed Zakat ontology is more accurate due to the hierarchy of class makkan_phase and then their individuals (verses). These hierarchies are not defined in Quran ontology, and it results in only keyword search of Makkah. Accuracy of relevant results of proposed Zakah ontology model is shown in the histogram.

5.3.4. Condition for Zakat

Condition for Zakat means when individual must pay Zakat. When the wealth crosses the threshold defined in Islam one must pay Zakat. These thresholds are different for different type of wealth e.g., on animals, gold, money, and property. In Quran, these values are not directly defined, so one must consult to hadith and tafsir. When this competency question is applied to Quran ontology, it results again Zakat keyword with 8.8 % accurate results only. Similarly, when this query is applied on semantic search-base Zakat ontology, 84 % accurate results are obtained. This query is well explained in hadith, so Quran ontology results in all irrelevant results, while due to exactness of dataset of proposed Zakat ontology results all the relevant data.

5.3.5. Benefits and Deniers of Zakat

Table 1: Comparison between Baseline Method and Proposed Method

SR. No.	Competency Questions	Quran Ontology			Zakat Ontology		
		TE	R	I	TE	R	I
1	Who deserves Zakat?	29	0	29	16	11	5
2	Was Zakat provision allowed in ancient civilization?	33	8	25	7	7	0
3	Was Zakat implemented before the migration of Prophet Muhammad (SAW)	30	5	25	7	7	0
4	What are the conditions of Zakat?	29	0	29	13	11	2
5	What are the benefits of Zakat?	45	4	41	10	10	0
6	What is the warning for deniers regarding Zakat?	38	0	38	10	2	8

Next competency question was benefits of Zakat and deniers of Zakat. When this query is applied to Quran ontology, one gets only 4 relevant verses about benefits and 0 results about deniers of Zakat. Baseline approach is keyword base and limited to Quran corpora. Like other questions it fails to provide relevant answers. Presented Zakat ontology is semantic search-base with wide domain, so it provides more relevant and accurate answers.

From the following histogram Figure 2 accuracy of proposed Zakat ontology can be seen. Some issues related to Zakat are not well defined or directly addressed in Quran, so one must consult with hadith and tafsir. Ontologies based on Quran cannot provides solutions to such quires. e.g., query related to conditions of Zakat. Zakat ontology addresses all issues because it provides semantic search on large data set.
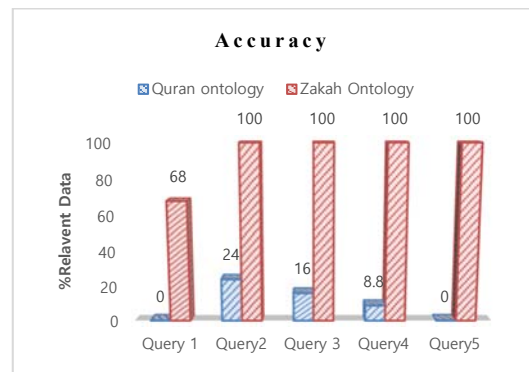

Figure 1: Performance Comparison in Terms of Accuracy.

6. Conclusion and Future Work

In this research, semantic search-base Zakat ontology is devolved to provide the appropriate and correct data set to all community from lay man to Islam computing researchers. Performance of proposed zakat ontology, with respect to baseline Quran ontology approach is discussed, in terms of relevant data extraction, semantic search, and contextual structure. From results, it is concluded that proposed Zakat ontology has helped us in solving different issues of Zakat, which are not directly mentioned in Quran. Search results of queries related to Zakat before migration of prophet (SAW) and conditions for Zakat are failed, in keyword search-base Quran ontology while proposed ontology provide fruitful results. Large data sets and semantic search deals all the topics and conditions related to zakat, which is deducted from results. Correct and wide vision of knowledge of Zakat is very important as it is religious obligation to all Muslims, so one can conclude from the results that only keyword search and Quran is not enough for gathering knowledge. Some irrelevant/repeated data is also retrieved which is due to web ontology language (OWL) property of equivalent class. It can be

retrieved properly with the Description logic (DL) query. That's why SPARQL is used, to retrieve duplicate results. From the competency question results of Quran and Zakat ontology are precise and accurate in ranking.

In future like Zakat ontology on even larger data set, ontologies on other pillars of Islam can be developed using semantic search-base tool. For avoidance of irrelevant data extraction, Description logic (DL) query can be employed.

Acknowledgments

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