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Semantic query for Quranic ontology

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ABSTRACT

The automatic processing of natural languages knew a remarkable growth in terms of techniques, methods and the variety of its potential applications. For instance, to automatize the processing of the Arabic language with its particular features, we selected the holy Quran as a study case. The latter has represented a challenge for the artificial intelligence.

The main objective of the present paper is to design the semantic search engine for the text of the Quran using Quranic ontology. To determine the semantic fields of the words of the holy Quran, the Quranic ontology was developed, that presents the meaning of words and their relations. This method is used for each concept in order to enrich the query.

1. Introduction

Currently, available models of search to the Quranic concepts exploit keyword-based searching, where statistical and keyword-based techniques have achieved some success in data mining and information retrieval systems.

To exploit the semantic-based techniques, the Quranic ontology was developed to presents the meaning of words and its relations; our goal is to request the database with the information retrieval systems and to guarantee exactness and reliability in the results.

Query expansion is a successful technique to overcome weaknesses in performance. The latter requires finding out equivalent word alternatives (synonyms) for all or some of query words. This is made by either the user intervention, usually called interactive query expansion, or it is made automatically without any of the above and usually called automatic query expansion see in (Rachidi et al., 2003).

Our contribution consists in creating a search engine using Apache Lucene. Also, it builds the Quranic ontology with a semantic relation between the terms of the holy Quran in order to expand the queries.

The organization of this research consists in: first, presenting the resources and illustrates the quranic ontology. Second, describing the system to enrich the query. Third, including the discussions and the justifications of the search result analysis, finally, summarizing the program illustration and discussing some further works.

2. The resources

The system use an indexed dictionary of words in The Quran ("المعجم المفهرس لألفاظ القرآن الكريم") found in (Zaki elkhedre, 2004). The dictionary takes into consideration the specificity of the word in the Holy Quran. The latter contains several databases, for each analysis level: morphological, syntactic, and semantic.

2.1. The basis of the morphological data

The construction of this database requires cutting words in the Quran in nuclei and affixes.

For example:

أفبالباطل " contains a prefix أ ف ب ال ـ ـ and the stem word "باطل " (void)

فسيكفيكهم " contains two prefixes at the beginning ف س - and two ending suffixes ك هم - and the stem word (suffice) يكفي.

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2.2. The basis of the syntactic data

The database was built according to the morphological structure. The difference is that the affixes can operate as independent words, and we can determine the syntactic analysis of each part of a word and the detailed information about it. There are some disagreements between specialists concerning the syntactic analysis of several words in the Quran, hence differences in meanings and interpretations; gender (male or female) and number (singular and/or plural) are also included.

2.3. The semantic database

This semantic database is formed around different criteria; the first one refers to the root word because there are links between roots, for example:

to arrive (قدم), to come (أتي), be Brought (جيء)

Crown (ولي), arrive (وصل), attend (حضر)

To enter (دخل), mastermind (دبر)

This set of words is semantically related to the human being movement.

The second criterion refers to the different patterns of the root word for example:

أقدم: Progress

تفاعل (تقادم),افتعل (اقتدم) ,فعل (قدم), أفعل (أقدم)

استفعل (استقدم) و تفعل (تقدم)

We can see the differences between the schemes (أوزان), the words table (see Table 1) of the dictionary is built around the following fields:

Seq: sequence number of the words of the Quran
Root: the root word
Word: the word
Othmani: the writing of the word
Prefix: several fields for prefixes.

3. The Quran related ontology

3.1. Definition of ontology

An ontological model is a formalized representation of lexical items as a recent and advanced model in the semantic web technology. The goal of the ontology is to provide a computational model able to represent word's meaning using semantic field theory and componential analysis. Representing meaning in such a way will enable the creation of useful natural language processing applications for Arabic, such as semantic analysis.

To conceive the semantic fields of the words in the holy Quran, the Quranic ontology was developed to present the word's meaning and its relations.

The Quranic ontology uses the knowledge representation to define the key concepts in the Quran. It shows the relationships between them using the underlying logic. We had an expert in Arabic linguistics involved throughout the development process. The fundamental concepts of ontology are based on the knowledge contained in the words of the indexed dictionary "المعجم المفهرس لألفاظ القرآن الكريم" found in (Zaki elkhedre, 2004). This dictionary is based on two traditional sources of Quranic analysis, the hadith of the Prophet Mohammed, and Quranic exegesis of Ibn Kathir.

3.2. The ontology conception

The model is based on componential analysis of word senses and semantic field theory; we classify the words in the hierarchical structure by levels; with different classes: linguistic concepts at the top, semantic field, general meaning, similar semantic field, semantic unit and semantic domain. We provide a textual description of ontology classes:

Linguistic concept: a class which represents all terminology used in the ontology.

Semantic Field: a class representing all existing semantic fields within the holy Quran.

General meaning: Entitle each semantic field as a global sense.

Similar Semantic Field: a class representing the similar of the semantic field.

Semantic unit: a class representing a single word.

Semantic Domain: a class representing a domain.

To obtain the words of classes we apply the following rules cited in (Zaki elkhedre, 2001):

- Collect all the used word contexts.
- Give the meaning in every context in which it appears.
- Gather the words with the same or related meanings in one semantic field.
- Entitle each semantic field as a global meaning.
- Create semantic and logical relationships between the fields' meaning.

In addition, we must clarify the exact meaning of each word and its context in the quran.

We apply the following scheme to all the sets of ontology classes' show in Fig. 1:

For example to obtain the meaning of the word justice we use several relations, the most important are listed below:

1. Relation of synonym: give the same meaning justice: " العدل و القسط ".
2. Relation of antonym: give the opposite of word justice and wrong "العدل و الظلم ".
3. Relation of hyponymy: give a semantic field of the word: "الغصب" irregularity and "العدوان " transgression.
4. Relation of similarity: give the similar of the word

البغي rebellion, Fading البهتان, slander الشطط.

The ontology classes of the word irregularity are shown in Fig. 2:

The ontology is created using Protégé 2000 open source software in OWL format (Web Ontology Language).

Furthermore, Protégé provides an application interface programming (API) written in JAVA. This API allows JAVA programmers to develop applications that can access to the Protégé knowledgebase shown in Fig. 3.

3.3. Ontology evaluation

The evaluation will include two stages:

1. Evaluate how well the ontology can present the word's meaning (word formation and its relations) via semantic analysis.
2. Test our ontology with all the words of the holy Quran. The Fig. 4 show extract of ontology:

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Table 1
Table of words.

SEQ	STEM	WORD	OTHMANI	ROOT	PREFIX1	PREFIX2
1	#	#	#	#		
2	@	@	@	@		
3	سمى	بِسْمِ	بِسْمِ	اسْم	بِ	
4	ءله	اللَّهِ	ٱللَّهِ	الله		
5	رحم	الرَّحْمَٰنِ	ٱلرَّحْمَٰنِ	رَحْمَن	ال	
6	رحم	الرَّحِيمِ	ٱلرَّحِيمِ	رَحِيم	ال	
7	@	@	@	@		
8	حمد	الْحَمْدُ	ٱلْحَمْدُ	حَمْد	الْ	
9	ءله	لِلَّهِ	لِلَّهِ	الله	لِ	
10	ربب	رَبِّ	رَبِّ	رَبّ		
11	علم	الْعَالَمِينَ	ٱلْعَٰلَمِينَ	عَالَم	الْ	
12	@	@	@	@		
13	رحم	الرَّحْمَٰنِ	ٱلرَّحْمَٰنِ	رَحْمَن	ال	
14	رحم	الرَّحِيمِ	ٱلرَّحِيمِ	رَحِيم	ال	
15	@	@	@	@		
16	ملك	مَالِكِ	مَٰلِكِ	مَالِك		
17	يوم	يَوْمِ	يَوْمِ	يَوْم		
18	دين	الدِّينِ	ٱلدِّينِ	دِين	ال	
19	@	@	@	@		
20	ءبى	إِيَّاكَ	إِيَّاكَ	إِيَّا		
21	عبد	نَعْبُدُ	نَعْبُدُ	نَعْبُد		
22	ءبى	وَإِيَّاكَ	وَإِيَّاكَ	إِيَّا	وَ	

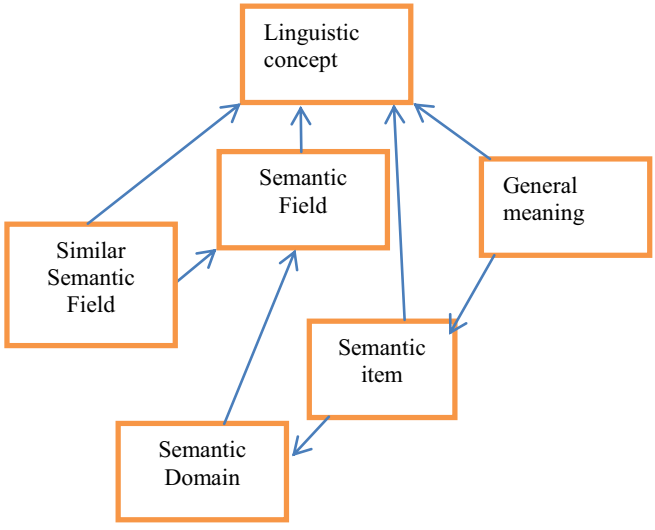

Fig. 1. Ontology classes.

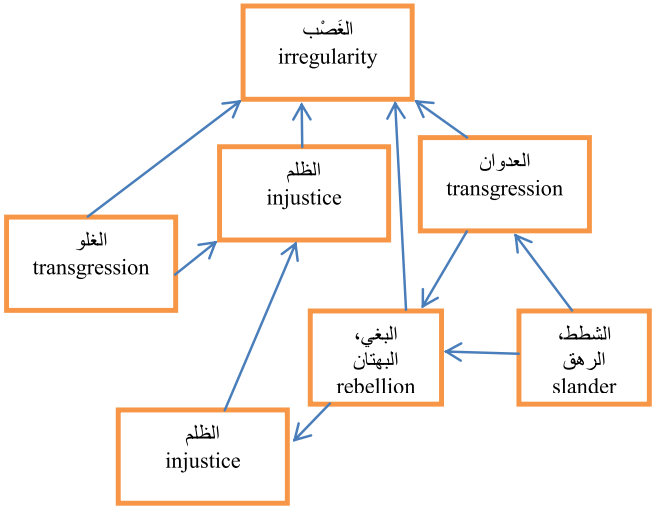

Fig. 2. Ontology classes of the word irregularity.

4. Related works

Query expansion techniques have been studied by many researchers. The most successful query expansion techniques depend on an automatic relevance feedback regardless of its semantic relations. Many researchers have examined the semantic query, and some of these researches are presented below in order to learn from all of these experiences:

4.1. The semantic query expansion approach

The query expansion approach is used with an ontology built upon Wikipedia pages. Other thesauruses that are used to improve the search accuracy for the Arabic language are cited in (Mahgoub et al., 2014).

This approach investigated two methodologies for query expansion; the first one is the most common query expansion methodology which is producing a single expanded query that contains all expanded terms.

The second methodology that was introduced is expanding each term one at a time producing multiple queries, and then combining these queries results into a single result list.

This approach discusses the main features of semantic search that makes it a better choice over the traditional keyword based techniques:

1. Handling Generalization
2. Handling Morphological Variations
3. Handling Concept Matches
4. Handling Synonyms With Correct Sense

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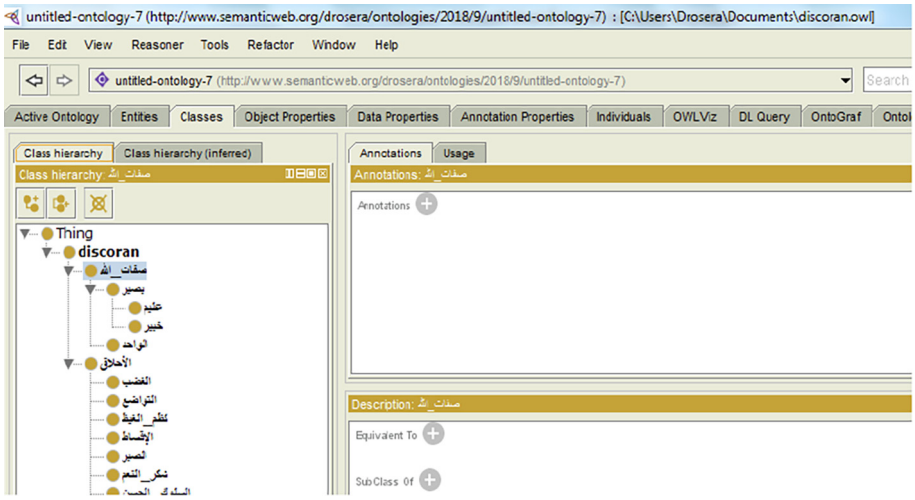
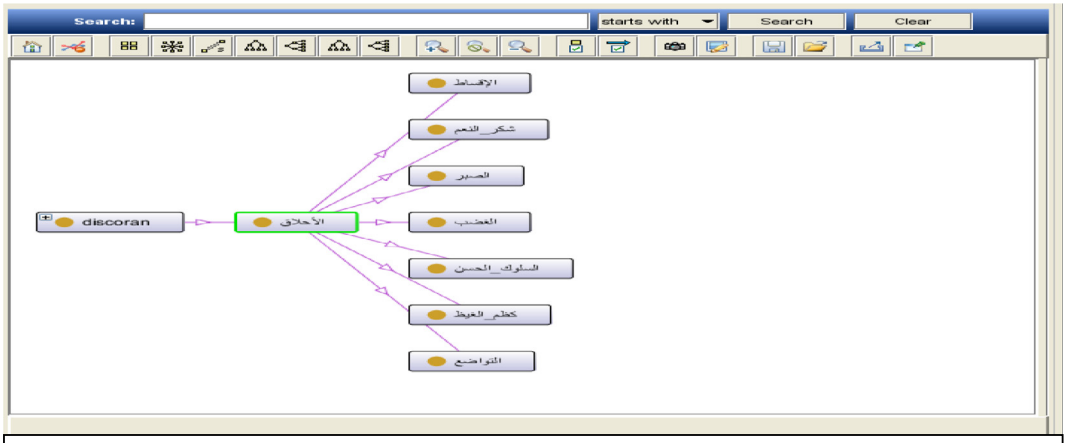


Fig. 3. The quranic ontology in Protégé.




```
owl:Class rdf:ID="الأخلاق">
  <rdfs:subClassOf rdf:resource="الإقساط"/>
</owl:Class>
  <rdfs:subClassOf rdf:resource="#شكر النعم"/>
</owl:Class>
  <rdfs:subClassOf rdf:resource="#الصبر"/>
</owl:Class>
<rdfs:subClassOf rdf:resource="#الغضب"/>
</owl:Class>
<rdfs:subClassOf rdf:resource="#السلوك الحسن"/>
</owl:Class>
<rdfs:subClassOf rdf:resource="#كظم الغيظ"/>
</owl:Class>
<rdfs:subClassOf rdf:resource="#التواضع"/>
```

Fig. 4. Ontology extract.

This approach suggests a different system from others on several ways:

(1) Adding "Subcategories".
(2) Adding Wikipedia "Gloss" when there is no "Redirect" page available.
(3) Allowing the user either to expand all terms in a single query, or to expand each term separately producing multiple queries. The result lists of these multiple queries are then combined into a single result list.
(4) Adding terms from two other supportive thesauri, namely "Al Raed"dictionary and "Google_WordNet" dictionary, these approaches are found in (Mahgoub et al., 2014).

4.2. The Axon system

Axon is a system for information retrieval which has the particularity of being adapted to the Arabic language and that provides personalized results based on the user's preferences/interests.

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This system provides a query expansion method based on both semantic knowledge from existing ontologies for the Arabic language and information from user's profiles.

This system of personalized information retrieval provides expansion method of queries based on semantic knowledge stemming from existing ontologies for the Arabic language (Amine Arabic WordNet and Arabic WordNet (AWN)) and on information coming from the users' profiles.

The user is invited to fill out a registration form related to his personal and professional data, and his research preferences. The construction of the user profile the domain tree is based on the extraction of the semantic relations found in the mentioned ontologies.

This method articulates around seven main following stages in order to know either the construction or the consultation for the user's profile, the query analysis, the query expansion, the research space reduction, the matching documents-query, the results reordering and filtering and the relevant passages extracting.

The suggested query expansion method has been implemented and tested on 150 queries for 50 users i.e. 7500 queries of evaluation are cited in (Safi, 2014).

4.3. The ontological model for the representation of semantic lexicons

This model is a calculation one to represent Arabic lexicons using ontologies. These ontologies are representation structures of knowledge which form the central building block of the semantic web.

The model is based on the linguistic theory of semantic fields, and on the data collected from the most accurate text that represents the superiority and perfection of the Arabic language, the Holy Qur'an.

This model is classified as a "data-driven" model, in which all the time names in the Holy Quran are used to obtain the ontological structure. The creation of such lexicons will be invaluable for a number of Arabic applications. The results of its application are presented on the vocabulary of "Temporal nouns" in the Holy Quran are found in (Al-yahya et al., 2010).

The uses vocabulary contains a total of 59 words (see Table 2). The model used 28 words as a basis for its design; the remaining 31 will be used for validation of the resulting one.

Results of the evaluation indicate that the model is able to represent word semantics in a way that can facilitate semantic analysis of Arabic words and various useful applications.

4.4. The interface for the enhancement of arabic queries in an information retrieval system

This interface utilizes a lexical resource and a morphology analyzer to reformulate (by expansion) the user's query in order to increase and refine the query results. This presentation focuses on an automatic expansion of Arabic queries using a morphological analyzer and the Arabic WordNet. After being processed the expanded queries will be sent then to Google.

The search information process consists of three parts: the query building, the response building and the response evaluation. The quality of the answer depends mainly on the quality of the query building. As a matter of fact, the query clearly elaborated is much more complex than its answer. To test this approach, Google search engine coupled with The Arabic WordNet are used; to present this interface in (Abderrahim, 2009). The search interface is divided into two important modules: the morphological analyzer and research module of concepts from WordNet. Two data resources are used:

– A linguistic database is used by the morphological analyzer. – WordNet Arabe. It is concluded that the evaluation of the real Arabic query's contribution and a enrichment is a very delicate task which requires thorough investigation. It is said that the contribution of ontologies in the information retrieval is characterized by:
– The silence reduced in the answers of the queries' users;
– Reduced of the number of noisy responses;
– making the query expression more easy (assistance in the formulation of the query).

4.5. Automatic query expansion for Arabic text retrieval based on association and similarity thesaurus

The automatic Arabic thesauri are designed and built using term-to-term similarity and association techniques that can be used to improve the arabic query expansion. The system consists of three integrated phases:

- Preparing documents.
- Building a traditional information retrieval system.
- Building thesauri.

The process of query expansion passes through three successive stages including the sending of query items to thesaurus, getting items similarity, and reformulation.

The work shows that the association-thesaurus has superior performance over the similarity-thesaurus. However, the work has many limitations over the traditional information retrieval system in terms of recall and precision level.

Experiments conducted on a selected 242 Arabic abstract documents from the National Computer Conference and 59 Arabic queries found in (Khafajeh et al., 2010).

The Evaluation of different techniques and methods was cited in Table 3:

5. The proposed system

The system is a semantic search engine for the text of the Quran using quranic ontology. The latter was developed, in a way to present the words' meaning and their linkages. This method is used for each concept in order to enrich the query; several steps are followed:

5.1. Lemmatization

The procedure is as followed:

- Cutting the words of the Quran in nuclei and affixes.
- Finding the root word in the DISCORAN database.
- Gathering all the words from the same root.

For example see Table 4:
The source in the text of the Quran:

واجتبيناهم وهديناهم إلى صراط مستقيم (الأنعام 87)

Translation: And We chose them and We guided them to a straight path (**sūrat l-anʿām 87**).

ولكن الله يجتبي من رسله من يشاء (آل عمران 179)

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Table 2
Time Nouns from the Holy Quran.

الآن، الأبد، الأجل، الأصيل، الأمة، الأمد، الأمس، الأناء، الإشراق، البكرة، البيات، التارة، الحجة، الحقبة، الحول، الحين، الدلوك، الدهر، الرواح، الزلفة، الساعة، السحر، السنة، الشتاء، الشفق، الشهر، الصبح، الصريم، الصيف، الضحى، الطبق ،الطور، الظهيرة، العام، العسعسة، العشي، العصر، العمر، العهد، الغد ، الغداة، الغسق ،الغطش ،الفترة، الفواق، القائلة، القرن، القطع، المدة، المساء ،المغرب ، الملي، الناشئة، الوقت، اليوم، الليل، النهار.

Table 3
Evaluation of different techniques and methods.

Techniques (or system)	Strengths	Limitations
The semantic query expansion approach	Produce multiple queries	Use google
The Axon System	Use Wikipedia ;"Al Raed"dictionary and "Google_WordNet" dictionary system for information retrieval use existing ontologies for the Arabic language (Amine Arabic WordNet and Arabic WordNet (AWN) use information from user's profiles	it is not exact and reliable in results. the semantic level does not exist in Amine Arabic WordNet and Arabic WordNet
The Ontological Model For The Representation Of Semantic Lexicons	the time names of the Holy Quran are used to obtain the ontological structure	The corpus is limited
The interface for the enhancement of arabic queries in an information retrieval system	Use morphological analyzer and the Arabic Wordnet. The expanded queries then sent to Google	Use Google it is not exact and reliable in results.
Automatic query expansion for Arabic text retrieval based on association and similarity thesaurus	built automatic Arabic thesauri use the process of query expansion The better values of precision and recall	no limitations

Translation: But [instead], Allah chooses of His messengers whom He wills **(sūrat āl ʿim'rān 179).**

وكذلك يجتبيك ربك ويعلمك من تأويل الأحاديث (يوسف 6)

Translation: And thus will your Lord choose you and teach you the interpretation of narratives (sūrat yūsuf 6)

شاكرًا لأنعمه اجتباه وهداه إلى صراط مستقيم (النحل 121)

Translation:[He was] grateful for His favors. Allah chose him and guided him to a straight path (**sūrat l-naḥl 121**).

ثم اجتباه ربه فتاب عليه وهدى (طه 122)

Translation: Then his Lord chose him and turned to him in forgiveness and guided [him] (**sūrat ṭā hā 122**).

فاجتباه ربه فجعله من الصالحين (القلم 50)

Translation: And his Lord chose him and made him of the righteous (**sūrat l-qalam 50**).

The words are translated with Sahih International, the words (واجتبيناهم، يجتبي، يجتبيك، اجتباه، فاجتباه) have the same root and the same meaning found in (Zaki elkhedre, 2001).

Table 4
Same word.

Arabic word	Stem
واجتبيناهم	اجتبى
يجتبيك	اجتبى
يجتبي	اجتبى
اجتباه	اجتبى
فاجتباه	اجتبى

5.2. Process of the query enriching

The user formulates his query by using his own terms; afterward the system proceeds the extraction of a set of terms from the quranic ontology, and will lead to production of a new one. Thus, once the query is enriched, it is sent to the search module which gives results to the user. As the following Fig. 5 illustrates:

The algorithm to follow:

- Search the entities or "root" concepts in the DISCORAN database.
- Use the ontology for each concept from which the query is enriched
- Send queries to our search engine.
- Treat the result of the queries.
- We execute an algorithm on the tree of our Quranic ontology.

Example of Search Algorithm by Ontology

Declaration
R:user query
W:word
t:the terms of ontology
V:Verses
For R1 query do
  For W1 do
  Extract all the terms of the ontology
    $t_1, t_2, ..t_i$
  For t_i do
  send Qt_i to the search engine
    IF t_i exist in DISCORAN
      Then recovered the verses V_i
    ELSE show message
      "incorrect word"
  End For
 End For
ranking of V_i
remove double V_i
End For

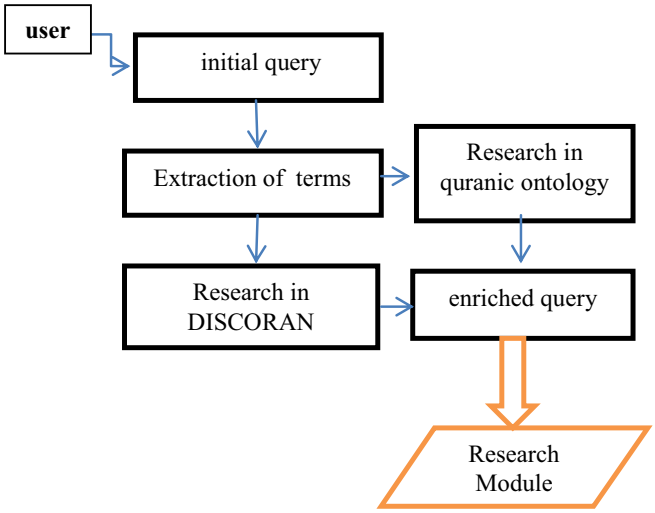

Fig. 5. The process of enrichment of the query.

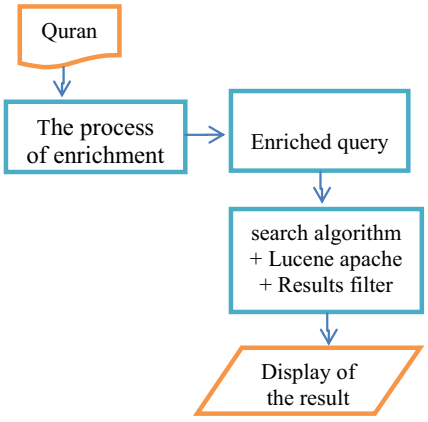

Fig. 6. The process of research.

5.3. Research module

The semantic search is based on the meaning of a word of the Quran i.e. the search for one or more meanings is done by means of the semantic relations between the words of the text of the Quran. Despite of its importance, only few researches use this methodology.

Lucene was added to our platform to add indexing capabilities to our DISCORAN database. The full-text Lucene search engine, a very popular open source library coming from Apache, was used because it allows powerful indexation features. It provides a simple API to its use which necessitates a basic understanding of indexation and search mechanisms found in (Apache, 2016).

Indeed, Apache Lucene is a high performance fully-featured JAVA text search library. This open source library allows adding searching capabilities in different types of applications that require full text search. Since Lucene is mature, free, open source and has an amazing performance, it's started being used in a diverse number of applications, websites and soft wares. However, as it is not dedicated to the Arabic language, morphological processing was added.

How to use it?

1. Add Documents to the Index.

Indexing is the process of converting text data into a format that facilitates a quick search.

2. Analyzer
3. Execution of the query.

The results of the query are displayed with every index including one of the ontology's components.

With indexation/full-text search, each word is indexed, to each of them, a reference is associated with the documents that contain this word.

First of all, it is necessary to index all the content which can be time-consuming, but then the search is accelerated in very large proportions. The performance increases exponentially with the volume of data. Indeed, it is no longer necessary to completely browse all the table records to find what matches them. It is enough to find the words in the index see in (Apache, 2016).

The use of the semantic resources during the research phase is translated by an expansion and a reformulation of the query, as the following Fig. 6 illustrates:

6. Experimental results

The quranic ontology is built with semantic relations in the Quran. Lucene was added to our platform, as it is not dedicated to the Arabic language, morphological processing was added. This platform is a search engine that allows semantic search in the Quran, it was developed by using JAVA programming language.

To evaluate our system, two already existing systems are used:

Alfanous Quran search engine: it is a search engine on the text in the holy Quran, based on some new technologies which ensures the speed of research. It is equipped with a morphological analyzer (root extraction . . . etc.). It presents other suggestions to the user see in (Assem, 2018).

Corpus Quran: it is a search engine of the text in the holy Quran, based on the morphological and syntactic analysis (Arabic grammar) of words, added to ontology concepts.

Moreover, it ensures the recitation of the holy Quran and its translation into the English language see in (Kais dukes, 2017).

Example1: as an example the word " "جاء is given. This example explains our approach; we treat a word with the its similar root and its close words.

For the word ""جاء: It is a verb that designates a human movement; according to our ontology, the words found are:

to arrive (قدم), to come (أتي), be Brought (جيء)

Crown (ولي), arrive (وصل), attend (حضر)

To enter (دخل), mastermind (دبر)

We seek different words in the sentence: جاء ربك , we use all the words generated by the ontology

So by expansion we will have

جاء ربك, أتى ربك ، قدم ربك ، حضر ربك ، وصل ربك ، تولى ربك ، أدبر ربك ، دخل ربك ، ولج ربك ، أقبل ربك و ورد ربك.

6.1. Main measures

In order to evaluate any system, the most commonly used measurements of retrieval performance are precision and recall. Precision measures the ability of the system to retrieve only documents that are relevant to a query. Recall measures the ability of the system to retrieve all documents that are relevant to a query (Lynda, 2009).

Precision = Amount of relevant retrieved documents /Amount of documents retrieved

Recall = Amount of relevant retrieved documents /Amount of relevant documents in the collection

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Table 5
Precision values for queries.

Word	Translation	Our system	Alfanous	Corpus quran
جاء ربك	God came	0.5	0.1	0.2
الله بصير	Allah is seeing.	0.7	0.3	0.6
الله خبير	Allah is Acquainted	0.8	0.7	0.7
الله عليم	Allah is Knowing	0.9	0.5	0.8
الحمد لله	praise is to Allah	1	1	0.0
الله أكبر	Allah is greater	0.6	0.3	0.3
رسول الله	The messenger of Allah	0.7	0.5	0.7
بسم الله	In the name of Allah	0.3	0.3	0.0
جنة الفردوس	Paradise	0.6	0.2	0.2
كتاب الله	Book	0.6	0.4	0.3
عبادي المؤمنين	My servants	0.7	0.5	0.5
الحياة الدنيا	The life of the world	1	1	0.0
فريضة من الله	An obligation	0.2	0.2	0.2
فعل المبطلون	Falsified have done	0.6	0.4	0.1
عذاب الحريق	The burning fire	0.6	0.5	0.5
سبل الله	In the cause of allah	1	1	0.8
ملك السموات و الأرض	Is the dominion	0.8	0.8	0.7
شديد العقاب	Is severe	1	1	0.9
قضى ربك	Has decreed	0.7	0.6	0.3
Average precision		0.700	0.542	0.410

In this experiment, we measured the precision of 19 queries for 6236 records (verses) in the Holy Quran text. Using the quranic ontology, we obtain 32 enriched queries; we applied the queries to the three systems Alfanous, corpus Quran, and our system. The precision was calculated for each search engine on the first 10 returned results, as the following table 5 shows the precision values:

We note that the Alfanous system does not give all the results for the query. The corpus Quran system gives good results but only for the first word. By using the quranic ontology, the system gives thorough results for all the words of the query.

The system gives 0.700 of average precision that is the better results because it uses semantic treatments with ontology, and it gives precision for the second words.

The system gives more accuracy to the results in order to satisfy the user researcher specialist, also ensures time saving.

7. Conclusion

The research consists in:

- Classifying the words in the hierarchical structure by levels; with different classes: linguistic concepts at the top, semantic field, general meaning, similar semantic field, semantic unit and semantic domain.
- Building the Quranic ontology with a semantic relation between the terms of the holy Quran to expand the queries.
- Creating the ontology using Protégé 2000 open source
- Basing the search on the meaning of the word in the holy Quran
- Creating a search engine using Apache Lucene.
- The platform is a search engine and allows semantic search in the Quran, it was developed using the JAVA programming language
- The system gives the better results because it uses semantic treatments with ontology

We conclude that this work is very important for our country in the field of automatic processing of the Arabic language.

Future project:

- To achieve accurate results and expand throughout the Arabic lexicon which is difficult semantically, and is in its initial stage.
- To generalize the ontology for other arabic text.

Confllict of interest

Generalize the ontology for other arabic text.

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