Provisions of Quran Tajweed Ontology (Articulations Points of the Letters, UN Vowel Noon and Tanween)

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Abstract: *The Holy Quran has rules that the reader must learn so that he can read the Qur'an correctly (Tajweed).The objective of this research is to design an ontology for some of Tajweed (Articulations Points of the Letters, Un Vowel Noon and Tanween) to support the learning of this part of Tajweed and to facilitate the sharing of knowledge with the other Holy Quran applications. In order to achieve this goal, the researchers adopted the applied approach using protégé framework with OWL to the provisions build the Ontology. The provisions of Quran Tajweed Ontology (Articulations Points of the Letters, Un Vowel Noon and Tanween) use knowledge representation to define the key concepts in Un Vowel Noon and Tanween (Clearness, Merge, Hiding, Change) and The Letters Articulations, and show the relationships between these concepts and its properties. The fundamental concepts in the ontology are based on the knowledge extracting from the Books of Tajweed, and some verses of the Holy Quran to infer the Provisions. The designed ontology can retrieves information about Articulations Points of the Letters, Un Vowel Noon and Tanween. Furthermore, it can be shared and reused in applications related to Holy Quran Tajweed.*

Keywords: Quran, Tajweed, Articulations Points of the Letters, Ontology, Un Vowel Noon, Tanween

1. Introduction

The Holy Quran is the word of Allah Almighty revealed by His Messenger Muhammad (peace be upon him). It is the primary source of universal laws and regulations for all Muslims and non-Muslims. Quran Tajweed is the set of rules governing the way in which the words of the Quran should be pronounced during its recitation.

Many researchers have built different Quranic ontologies to facilitate the retrieval of knowledge

From Al-Quran, with a minority of these ontologies covering all Al-Quran chapters. Most of the ontologies built for the Qur'an are incomplete and/or focused in a limited specific domain [2], and there is no more Tajweed ontology.In this paper we will design ontology for Quran Tajweed Provisions, part of these rules (Articulations Point of the Letters, Un Vowel Noon and Tanween).

Before starting to build the Ontology, we highlight some concepts:

Ontology is an explicit specification of a conceptualization. The term is borrowed from philosophy, where Ontology is a systematic account of Existence. For AI systems, what "exists" is that which can be represented [3].

Un Vowel Noon (Noon sakinah) is a noon free from any vowel(حركة). It remains unchanged in its written form and as well as in pronunciation when continuing to read after it and when stopping on it. Noon sakinah occurs in nouns and verbs in the middle of the word and at the end of the word, and occurs in prepositions and particles(حروف)only at the end of the word. The noon sakinah can have a (sukoon) on it, as inمِنْهُمْ ; or can be written withno vowel on it, as inمَن [3].

Un Vowel Noon has four rules:
- The Clearness.
- The Merge.
- The Hiding.
- The Change

The Tanween is a term for an extra noon saakinah not used for emphasis, found at the end of nouns when continuing the reading, but absent fromthe noun in the written form (the noon of the Tanween is pronounced but not written), and abandoned in pronunciation when stopping. The Tanween can be accompany akasrah, or a dhammah, or a fathah, as in(◌ٌ◌ً) [3].

Articulations Point of the Letters is the place of emitting the letter when pronouncing it thatdifferentiates that specific letter from other letters
- **The empty space in the mouth and throat**:has one articulation point for the three, lengthenedletters: **الألف, الواو, الياء**.
- **The Throat:**has two articulations points for six different letters which are pronounced from the deepest, middle and closest part of the Throatالهاء, الهمزة: الخاء, الغين, الحاء, العين.
- **The Tongue:** it has tenarticulations points for eighteen letters القاف, الكاف, الجيم, الشين,الياء غير المدية, الضاد, اللام, النون, الراء, الطاء, الدال, التاء, الصاد, الزاى, السين, الظاء, الدال, الثاء.
- **The Two Lips:** it has twoarticulations points for four letters: الفاء, الواو غير المدية, الميم, الباء.

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- **The Nose:** from the hole of nose towards the inside of the mouth, here is one articulationpoint is that for **Ghunnah**[3].

The diagram below (Figure1) shows a visual representation of the ontology.

2. Method

Ontology engineering (or ontology building) is a subfield of knowledge engineering that studies the methods and methodologies for constructing ontologies. It studies the ontology development process, the ontology life cycle, the methods and methodologies for building ontologies, and the tool suites and languages that support them. Here we use Protégé which is a free, open source ontology editor and OWL which is the most recent development in standard ontology languages to build our ontology.
Ontology Engineering is a set of tasks related to the development of the ontology of a specific domain [4].

Figure1: Classes of UN Vowel Noon and Tanween

Figure2: Ontology Development [4].

As in (Figure2),the main steps in the methodology are as follows:

2.1 Determine the domain and scope of the ontology

Starting the development of ontology by defining its domain and scope. That is, answer several basic questions:
- What is the domain that the ontology will cover?
- For what we are going to use the ontology?
- For what types of questions the information in the ontology should provide answers?
- Who will use and maintain the ontology?

The answers to these questions may change during the ontology-design process, but at any given time they help limit the scope of the model[5].

We did our ontology on part of Quran Tajweed, Specifically the provisions of the Un Vowel Noon and Tanween. One of the ways to determine the scope of the ontology is to write down a competency questions,which are a list of questions that the design ontology should be able to answer it. Such as:
- What is UN Vowel Noon?
- What is Tanween to?
- What are the letters of Ghunnah?
- What are the UN Vowel Noon and Tanween provisions?
- What are the articulations of the letters?
- Give an example of throat's Letters?
- Give an example of Clearness?
- What is the letters of Change?
- How many letters come out from tongue?

And so on...
Judging from this list of questions, the ontology will include the information that the user need to retrieve about UN Vowel Noon and Tanween provisions, articulations of the letters.

2.2 Consider reusing existing ontologies

Reusing existing ontologies may be a requirement if a system needs to interact with other applications that have already committed to particular ontologies or controlled vocabularies [6]. This ontology was constructing from scratch.

2.3 Enumerate important terms in the ontology

At this stage we write down all terms that can be in the domain. In our ontology terms can be as follow:

The Articulation Point of the Letter, The Empty Space of the Mouth and Throat, The Nose, The Two Lips, The Tongue, Deepest Part of the Tongue, Edge of the Tongue, Middle of the Tongue, Tip of the Tongue, The Throat, The Closest Part of the Throat, Deepest Part of the Throat, The Closest Part of the Throat, The Un Vowel Noon and Tanween Rules, Un Vowel Noon, The Change, The Clearness, The Hiding, The Merging, With Ghunnah, Without Ghunnah, Tanween, get out from, is part of, subsumes, has applied definition, has linguistic definition, has wards, has example, and so on[3].

Initially, it is important to get a comprehensive list of terms without worrying properties that the concepts may have, or whether the concepts are classes or slots.

2.4 Define the Classes and the Class Hierarchy

At this stage the concepts of the domain will be arranged hierarchically through the Class and subclass relationship. Class hierarchy can be developed throw several adopted approaches: Top-Down and Button-up.

The ontology has been built using first approach with two main classes as follow:
1) **The Articulation Point of the Letter**with its sub classes**:**
   a) **The Empty Space of the Mouth and Throat.**
   b) **The Nose.**
   c) **The Two Lips.**
   d) **The Tongue,** with its sub classes**:**
      - Deepest Part of the Tongue.
      - Edge of the Tongue.
      - Middle of the Tongue.
      - Tip of the Tongue.
   e) **The Throat, with its sub classes:**
      - The Closest Part of the Throat.
      - Deepest Part of the Throat.
      - The Closest Part of the Throat.
2) **The Un Vowel Noon and Tanween Rules,**with its sub classes**:**
   a) **Un Vowel Noon:**
      - The Change.
      - The Clearness.
      - The Hiding.
      - The Merging, with its sub classes:
   b) **With Ghunnah, with its sub classes:**
      - Complete.
      - Incomplete.
      - Without Ghunnah.
   c) **Tanween.**
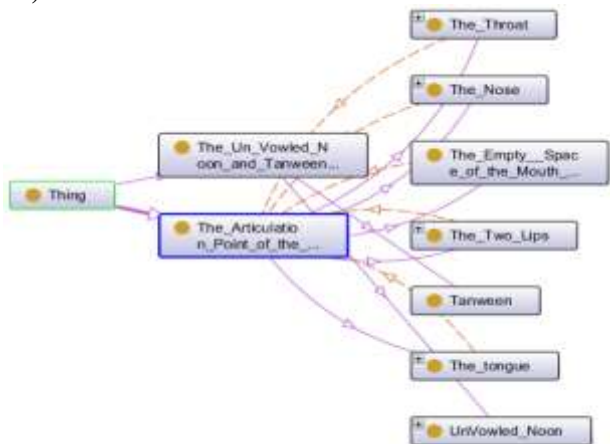
Figure 3: The Main Classes.

2.5 Define the properties of classes

We have already selected classes from the list of terms we created in Step 3, but the classes alone will not provide enough information to answer the competency questions

from Step 1. Once we have defined some of the classes, we must describe the internal structure of concepts [5].

OWL Properties represent relationships. There are two main types of properties, Object properties and Datatype properties. Object properties are relationships between two individuals, Datatype properties are between individuals and Data type.OWL also has a third type of property, Annotation properties. Annotation properties can be used to add information (metadata — data about data) to classes, individuals and object/Datatype properties [6].

According to Provisions of UN Vowel Noon and Tajweed ontology, the Properties will be like:
1) **Object Properties:**
   - get out from:
   - is part of
   - subsumes
   - has one word.
   - has two words.
   - has type.
For example get out from: links an individual of class **Clearness** to an individual of class **Throat**.

2) **Data Properties:**
   - has applied definition.
   - has linguistic definition.
   - has wards.
   - has example.
   - for example has linguistic definition.: links an individual of class **Clearness** to **String** DataType.
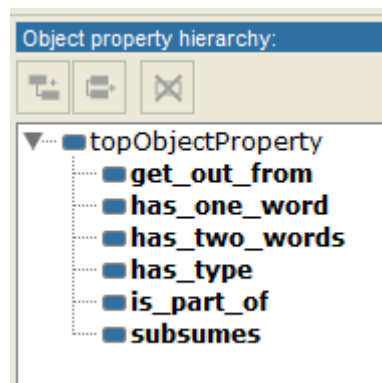

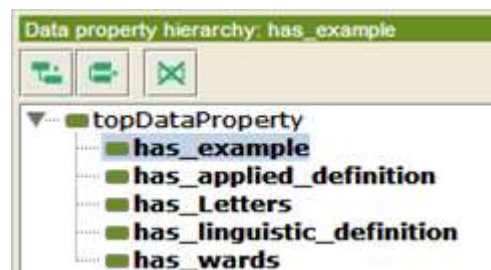**Figure 4:** Object Properties Hierarchy.

Figure 5: Data Properties Hierarchy.

2.6 Define properties of properties

Here we will define properties for each property. Properties might be:

- **Cardinality constraints:**are used to talk about the number of relationships that an individual may participate in for a given property. Cardinality restrictions come in three flavors: Minimum cardinality restrictions, Maximum cardinality restrictions and exact cardinality restrictions.

For example in our ontology **Tanween** should be in two words [3], as in (Figure6). This constrain written use cardinality constrain as shown in (Figure7).

Also, when one of the letters of **The Merge** comes after the UN Vowel Noon, and it was in **one word**there is no **Ghunnah**, but called **Absolute** as in (Figure8) , It comes only in **four words** in the Holy Quran{ قنوان, صنوان, بنيان, الدنيا } [3]. Such class called **Enumerated Class.**

Figure 6: has_word Property
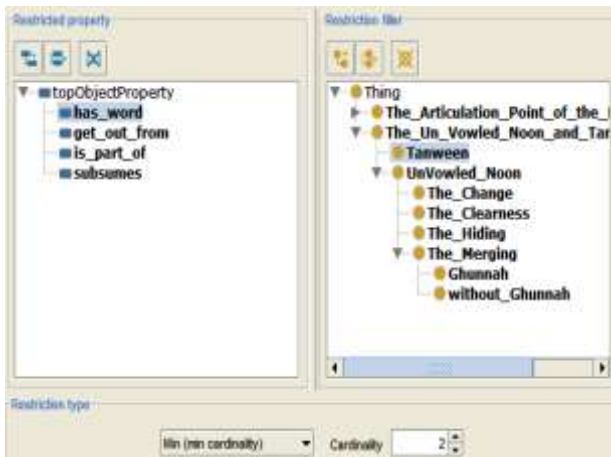
Figure 7: Cardinality Constraint for has_word Property

Figure 8: Enumerate class Absolute with its members

- **Data Type constraints**: Data type properties describe relationships between individuals and data values.
- **Range constraints and Domain constraints:** Properties may have a domain and a range specified. Properties link individuals from the domain to individuals from the range. For example, in this ontology, the property **get_out_from**would probably link individuals belonging to the class **The_Clearness**to individuals belonging to the class of **The_Throat**. In this case the domain of the **get_out_from** property is **The_Clearness**and the range is **The_Throat** this is depicted in (Figure8).
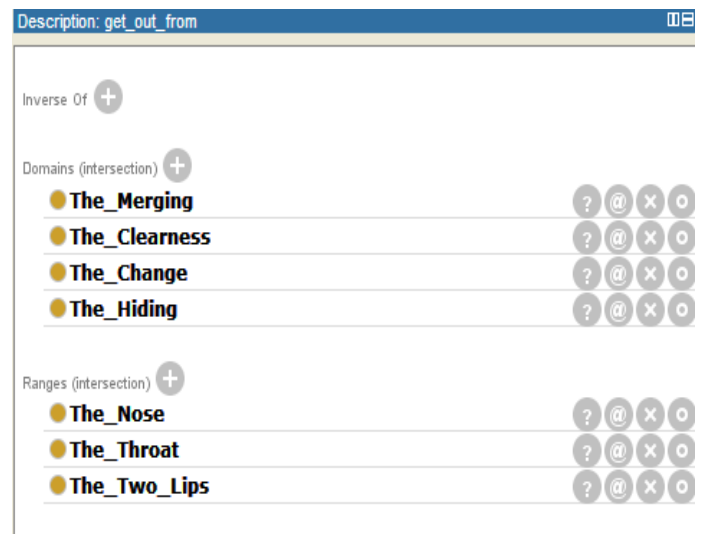

Figure9: Domain and Range of get_out_from Properties.

2.7 Create instances

At this level the ontology populate with instances of all classes. For example, class **Ghunnah** has instances such as النون, الميم, الياء, الواو غير المدية as shown in (figure9). Also, itmay have more details with verses from Quran as in (figure10). And so for other classes.
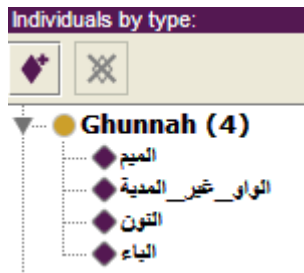
Figure10: Class Ghunnah Individuals.

Figure11:الميم Instanced with more Information

3. Results

After completing the design of the ontology, and ascertaining that all the classes are consistent via using the Reasoner, the researchers inquired about some information. We used DL Query and SPARQL Query to inquireabout Articulations Points of Letters, Provisions of UN Vowel Noon and Tanween.

For Example,
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
SELECT ?subject ?object
WHERE { ?subject rdfs:subClassOf ?object }

This Query through SPQRQL Query, which will Retains back all subjects and objects of the ontology as in (Figure11).

Figure12: Query of Whole ontology Elements.

When we used DL and inquired about The Merging (الإدغام), the result was as shown in (Figure12). This is all information about Merging.

Figure13: The_Merging Query Result

3.1 Results Discussion

The user can specify what part of the query he wants to be appeared through the selection buttons on the right of the DL Query window, such as Super classes, Ancestor classes, Subclasses, Descendent classes, Individuals. (Figure12). Furthermore, user also can do so when using SPARQL Query by selects what concept he wants to look for -Class, subclass or Object- through the below Query statement.
SELECT ?subject ?object
WHERE { ?subject rdfs:subClassOf ?object }
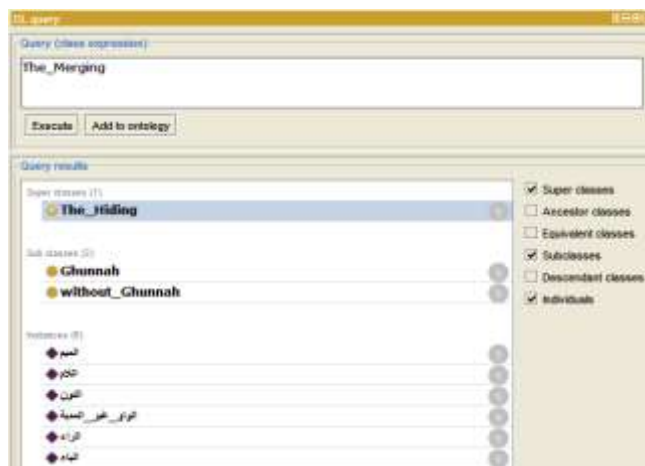
Figure14: Selective Member.

Other Resources

- "عون المريد في فن التجويد"we use this book to understand the Provisions of UN Vowel Noon and Tanween, and how can we arrange the hierarchy of the ontology classes and the relationships between these classes.
- http://quran.ksu.edu.sa/tafseer/tabary/sura108-aya2.html. From this site we take the verses that include into the ontology.
- http://protege.stanford.edu/download/protege/4.3/installanywhere/Web_Installers/

This site where we download the tool that used to build the ontology.

4. Conclusion

The researchers designed ontology for the Provisions of Quran Tajweed using Protégé framework with OWL language. They organized the concepts of Un Vowel Noon and Tanween through using classes and properties that identify this class and define the relationships between them. Furthermore, they also put restrictions on some properties according to what the rules of Tajweed stipulate. Also, they added instances to each class. And we ensured that all the classes are consistent with each other by using the Reasoner. Finally, some Queries were applied to the ontology using both DL Query and SPARQL Query, and thanks to God, it retrieved correct information.

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