Building Hadith Ontology to Support the Authenticity of Isnad

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ABSTRACT
The two fundamental sources of Islamic legislation are Qur'an and Hadith. Hadiths, or prophetic traditions, are narrations originating from the sayings and actions of Prophet Muhammad (peace be upon him). Isnad or Sanad is the chain of narrators attesting to the historical authenticity of a particular Hadith. It helps differentiate between the accepted and rejected Hadiths. In this paper we build a domain specific ontology (Hadith Isnad Ontology) to support the process of authenticating/judging Isnad. We evaluate the ontology through Hadith example and DL-Queries. The developed ontology will be used (in a future work) to automatically generate a suggested judgment of Hadith Isnad.

***Keywords*: Ontology Engineering, Ontology Evaluation, Domain-Based Ontology, Hadith Ontology, Hadith Isnad.**

1. Introduction

Hadith is oral traditions related to the words and deeds of Prophet Muhammad (peace be upon him). The traditional Muslim schools of jurisprudence regards Hadith to constitute an important tool for understanding the holy Qur'an and an essential part of all matters related to jurisprudence. A given Hadith consists of two parts: the actual narration, known as Matn (**المتن**); and the chain of narrators (reporters) through whom the narration has been transmitted, traditionally known as Isnad (**إسناد**). Isnad consists of a chronological list of the narrators, each mentioning the one from whom he heard the Hadith all the way to the prime narrator of the Matn followed by the Matn itself (التركي، 2007) (Azmi & Bin Badia, 2010).

Hadith scholars agreed that Isnad of Hadith is required in the narration of Prophetic Sunnah and it is a condition to work it out, otherwise, the Hadith is not accepted, and Imam Abdullah Bin Mubarak (d. 181 AH) said: "Isnad is part of the religion: had it not been for Isnad, whoever wished to would have said whatever he liked." (الرفاعي، 2004). Research in Isnad is very important for the science of Hadith. In order to know whether Hadith is authentic or not, Hadith scholars follow clear steps in judging Isnad. These steps are considered as traditional methods.

Software tools like electronic Hadith encyclopedias and some Hadith websites have been used to help in judging Isnad. More recent tools, such as ontologies, related to the semantic web can be used to serve in the process of judging Isnad. Ontologies are a semantic web building block that can be used in many applications, like information retrieval systems and decision-support systems (Kalfoglou, 2004). Ontologies can also be helpful in the process of judging Isnad. An ontology is a formal explicit description of concepts in a domain (classes), properties of each concept describing various features and attributes of the concept (slots or properties), and restrictions on slots (facets) (Wache, et al., 2001). An ontology together with a set of individual instances of classes constitutes a knowledge base (Al-Safadi, Al-Badrani, & Al-Junide, 2011).

In this paper, we design a domain-dependent ontology, called Hadith Isnad Ontology, for Isnad judgment in the Hadith domain. It structures Hadith concepts into a set of equivalent classes, properties, and relationships. One such concept is the narrator of a Hadith who is the main constituent of Isnad. The ontology captures all the properties and relationships of a narrator hence forming the necessary foundation for judging Isnad. After building the ontology, we evaluate it through Hadith examples to show that indeed the ontology represent all necessary and relevant knowledge about Hadith. We also evaluate the ontology through DL-query examples to show and test its usability. The developed ontology is considered as the basic building block in the development of a complete ontology-based Isnad judgment system.

The paper is organized as follows: Section 2 presents some related works, Section 3 presents the ontology development process, Section 4 presents the evaluation of the ontology, Section 5 represents a discussion of the ontology and its envisioned use in a system for judging Isnad, and Section 6 concludes the paper.

2. Related Work

A Solat (prayer) domain ontology is developed by (Saad, Salim, Zainal, & Muda, 2011). It represents an attempt to understand the characteristics of an ontology development as a concept of Islamic knowledge. In Solat-based ontology development, they use information from multiple sources provided by domain experts. It involves Qur'an, authentic Hadith, and books that focus on the Shafie's school of thought. The ontology developed from information gathered by domain experts, and assigned to the ontology expert in the form of a set of concepts, relationships, and definitions.

To enrich the Arabic content in the Semantic Web, Al-Safadi, Al-Badrani, & Al-Junide, (2011) proposes a model for representing Arabic knowledge in the computer technology domain through using ontologies. The model starts by elicitation of users' informational needs. The ontology is designed based on the Web Service Modeling Ontology (WSMO) framework Roman, et al.,(2005) for modeling semantic web services. They model the ontology first and then use this ontology as a domain model to form the basis of the generation of the semantic search engine.

There exist various electronic encyclopedias that are helpful in Hadith judgment like Multaqa Ahl al-Hadeeth Forum (http://www.ahlalhdeeth.com), Shamela library (http://www.shamela.ws), Encyclopedia of Harf: the Nine Books (http://www.harf.com), Aldourar Alsunnia (http://www.dorar.net/enc/Hadith). From our review, we noticed that they all are similar in their judgment of Hadith. In judging Hadith, they depend on the efforts of the user who needs to search for a narrator. They usually provide the narrators' chain and the biography of the entire narrators with name, surname, death date, layer, rank, teachers, and students. However, Encyclopedia of Harf additionally draws a tree of the Hadith Isnad. Aldourar Alsunnia prioritizes the author's judgment such as Imam Bukhari, Imam Muslim, and Al-Albani. Although Hadith electronic encyclopedias have useful features, they lack the automation of judgment on Hadith Isnad resulting in time-consumption and much of the effort lies on the researcher of the Hadith.

iTree Azmi & Bin Badia, (2010) automatically generates the narrators' chain of a given Hadith and graphically displays it. This process involves creating natural language lexer, performing shallow parsing, building syntactic analyzer, and finally a graph presenter that displays the narrators' chain graphically. e-Narrator Azmi & Bin Badia (2010) is based on iTree and parses a plain Hadith text and automatically generates the full narration tree. It involves parsing and annotating the Hadith text and recognizing the narrators' names. It uses shallow parsing along with a domain specific grammar to parse the Hadith content. Moreover, it uses a transformation mechanism based on ontology to represent the narration chain in a standard format and then graphically renders its complete tree.

The experiments on sample Hadiths show that eNarrator has acceptable success rate. But it has a limitation in that it is based on Sahih Muslim book only. The effect of this limitation is that it can't draw the Isnad tree for all Hadiths in the six books. Additional limitation that we are trying to overcome in our research is that it only generates a narration tree which cannot be used for making judgment on the Isnad. In our paper we use eNarrator's HatihRDF ontology as a basis for our ontology and enrich it with more properties, relations and attributes related specifically to narrators.

3. The Hadith Isnad Ontology Development

Hadith Isnad Ontology is developed based on the knowledge of the well-established science of Hadith and by the assistance of an expert in the science of Hadith. He helped in identifying concepts, characteristics, relationships, and definitions in the Hadith domain. The development methodology we adopted is widely known Noy & McGuinness (2001) and consists of: determining the domain and scope of the ontology, reusing existing ontologies, enumerating the important terms in the ontology, defining the classes and the class hierarchy, defining the properties of classes (slots), and defining the facets of the slots and finally creating instances (individuals) in the ontology to establish some sort of a knowledge base. Next we elaborate in these steps.

Step 1: Determining the Domain and Scope of the Ontology

Determining the ontology domain and scope involves answering the following basic questions:

1. What is the domain covered by the ontology?
   The domain of the ontology will cover the Hadith Isnad.
2. What is the use of the ontology?
   The ontology is to provide a knowledge base of narrators and Hadiths and can be used to make judgments on the Hadith Isnad.
3. What types of questions that would be answered based on the ontology?
   The ontology would provide comprehensive answers to questions related to Isnad like:
   – What is the First Name of a Narrator?
   – What is the descent (*Nasab*) of a Narrator?
   – What is the category (*Tabaqa*) and rank (*Rotba*) of a Narrator?
   – Who are the Teachers and Students of a Narrator?
   – What are the Hadiths that a Narrator has a muddle (*Ikhtelat*) about?
   – Who are the Narrators of a Hadith that a Narrator ignored (*Irsal*) in Isnad?
4. Who will use the ontology?
   The ontology will be available to any developer, expert, or system specialized in or related to the science of Hadith and its Isnad especially identifying a narrator's status. A narrator's status is very important to judge the Isnad of a given Hadith.

Step 2: Reusing Existing Ontologies

We use HadithRDF ontology Azmi & Bin Badia (2010) as a basis for our Hadith Isnad Ontology. Although it fills short in satisfying the requirements of our ontology because it is only an RDF definitions that describe the structural relationships rather than the semantic relations and properties, it represents the basic information needed in any Hadith ontology such as *Hadith*, *Hadith Book*, *Chapter*, *Narrator* and relationships among them. We use it to identify narrator's names and information that is needed in the process of judging the Isnad. HadithRDF ontology specification is written using RDF and is described as n-triples in the form of subject – predicate – object. It describes *Hadith* books in the Hadith corpus, e.g., Sahih Al Bukhari. Each *Book* has chapters and each *Chapter* has multiple Hadiths with each narrated by several *Narrators*. Fig. 1 illustrates the classes of HaithRDF and the set of relations along with the proper associations between them.

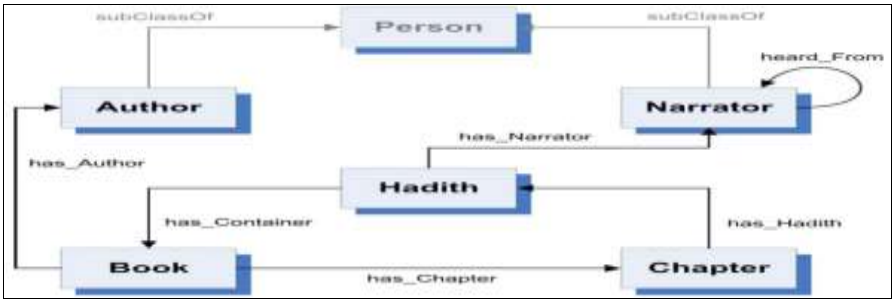

Fig. 1: HadithRDF Ontology **(Azmi & Bin Badia, 2010)**

Step 3: Enumerating the Terms in the Ontology

This step represents a brainstorming activity to determine the main terms to be used in the Ontology. We use the basic terms used in HadithRDF Ontology Azmi & Bin Badia, (2010) as

a basis of the terms that we want to use. We add more properties for these terms by studying the science of judging Hadith Isnad and through analyzing the structure of Hadith in the six Hadith books. The following questions guide our activity of determining the terms:

1. What are the main terms in the ontology?
   The main terms are Book, Hadith, Person, Author, and Narrator.
1. What are the properties of these terms? What is needed to be said about these terms?
   - The Book term has the following properties: *hasAuthor, hasChapter, ContainerOf, hasHadith, Content, NoOfPages, Title, Topic, and YearOfPublication.*
   - The Hadith term has the following properties: *HadithOf, hasContainer, hasNarrator, BedaaHadiths, WahemHadiths, IkhtelatHadiths, Title, and Topic.*
   - The Person term has the following properties: *Id, Name Gender LiveIn, Nasab, FirstName, FatherName, FatherNickName, GrandFatherName, GrandFatherNickName, FourthName, FourthNickName, FifthName, FifthNickName, BirthYear, DeathYear, OriginallyFrom, and DenotedBy.*
   - The Author term has the *AuthorOf* property.
   - The Narrator term has the following properties: *HeardFrom, TransferTo, notHeardFrom, NarratorOf, IrsalAbout, FatherOf, hasFather, MotherOf, hasMother, BrotherOf, hasBrother, GrandFatherOf, UncleOf, hasGrandFather, hasUncle, CousinOf, hasCousin, NephewOf, hasNephew, DaughterHusbandOf, hasDaughterHusband, GrandSonOf, hasGrandSon, MawlaOf, hasMawla, AttributedToGrandfather, Konia, Luqab ,Rotba, Tabaqa, Tadlees, hasBedaa, hasIkthelat, hasIrsal* and *hasWahem*.

Step 4: Defining Classes and Class Hierarchy

Based on the list created in Step 3, classes are terms that are selected whether they describe objects having independent existence or terms that describe these objects. Table 1 shows the terms determined in Step 3 as classes in the ontology.

Table 1: The Hadith Isnad Ontology Classes

No.	Class	Description
1	Hadith	Represents the Hadith Matn and Isnad
2	Person	Represents information about a human being
3	Narrator	Represents a person who narrates Hadith
4	Author	Represents author of the book
5	Book	Represents book of Hadith
6	Chapter	Represents chapter in Hadith book

They will become anchors in the class hierarchy since they will be organized into a hierarchical taxonomy. A top-down approach is used to build the class hierarchy: we define top-level classes such as Book, Chapter, Hadith, and Person then define subclasses that could expand from them.

Step 5: Defining the Properties of Classes (Slots)

This step clarifies and reflects the internal structure of the classes. For each class, the set of properties are defined and attached to the class as slots. For Example: *Person* has two types:

Narrator and *Author*. Every instance of *Narrator* has properties such as *HeardFrom*, *hasFather*, *TransferTo*, *NarratorOf*. Table 2 illustrates object properties of the ontology. Object properties allow us to create associations or relationships between class instances.

Table 2: Hadith Isnad Ontology Object Properties

Object Properties	Description
AuthorOf	Book that the author/person is an author
hasAuthor	Refers to the person who authored the book
ChapterOf	Book that hosts the chapter
hasChapter	Chapter that this book hosts
ContainerOf	Hadith that this book contains
hasContainer	Book that contains this Hadith
HadithOf	Chapter that hosts the Hadith
hasHadith	Hadith that this chapter contains
HeardFrom	The narrator who hears the Hadith
TransferTo	The narrator who told the Hadith
notHeardFrom	The narrator who did not hear the Hadith
NarratorOf	Hadith the narrator is narrating
hasNarrator	Narrator who narrates Hadith
IrsalAbout	Narrator who Irsal Hadith About Narrator
BedaaHadiths	Hadith Contains Bedaa of Narrator
WahemHadiths	Hadith Contains Wahem Narrator
IkhtelatHadiths	Hadith form Ikhtelat of Narrator
FatherOf	Narrator is Father of Narrator
hasFather	Narrator has Father Narrator
MotherOf	Narrator is Mother of Narrator
hasMother	Narrator has Mother Narrator
BrotherOf	Narrator is Brother of Narrator
hasBrother	Narrator has Brother Narrator
GrandFatherOf	Narrator is grandfather of Narrator
hasGrandFather	Narrator has grandfather Narrator
UncleOf	Narrator is Uncle of Narrator
hasUncle	Narrator has Uncle Narrator
CousinOf	Narrator is Cousin of Narrator
hasCousin	Narrator has Cousin Narrator
NephewOf	Narrator is Nephew of Narrator
hasNephew	Narrator has Nephew Narrator
DaughterHusbandOf	Narrator is Daughter Husband of Narrator
hasDaughterHusband	Narrator has Daughter Husband Narrator
GrandSonOf	Narrator is Grandson of Narrator
hasGrandSon	Narrator has Grandson Narrator
MawlaOf	Narrator is Mawla of Narrator
hasMawla	Narrator has Mawla Narrator

Table 3 illustrates the data properties of the ontology. Data properties help us describe instances and usually are typed data. For example the *Id* takes an integer value while *Name* takes a string value.

Table 3: Hadith Isnad Ontology Data Properties

Data properties	Description
Id	The identifier of the person
Name	The Name of the person
FirstName	The First Name of the person
FatherName	The Father Name of the person
FatherNickName	The Father Nick Name of the person
GrandFatherName	The Grandfather Name of the person
GrandFatherNickName	The Grandfather Nick Name of person
FourthName	The Fourth Name of the person
FourthNickName	The Fourth Nick Name of the person
FifthName	The Fifth Name of the person
FifthNickName	The Fifth Nick Name of the person
Konia	The Konia of the Narrator
Luqab	The Luqab of the Narrator
Nasab	The Nasab of the Narrator
BirthYear	The Birth Year of the Person
DeathYear	The Death Year of the Person
Gender	The gender of the person
LiveIn	The Country of the person
OriginallyFrom	The Country of the person
DenotedBy	The Nick name of the person
Rotba	The Rotba of the Narrator
Tabaqa	The Tabaqa of the Narrator
hasTadlees	The Tadlees of the Narrator
AttributedToGrandfather	The Narrator is Attributed to Grandfather
hasBedaa	Represents if Narrator has Bedaa
hasIkthelat	Represents if Narrator has Ikthelat
hasIrsal	Represents if Narrator has Irsal
hasWahem	Represents if Narrator has Wahem
Content	The Hadith content (Matn)
NoOfPages	Represents the number of pages in a book
Title	The resource title e.g. book, chapter and Hadith titles
Topic	Represents the Hadith topic
YearOfPublication	The year in the book was published

Step 6: Defining the Facets of the Slots

Slots have different facets that describe the value type, allowed values, the number of values (cardinality), and other features of values the slot can take. In our case most of the slot values are string and integer encoded using either ASCII or UTF-8 (Arabic). For example, the value type of *Name* property is string and the value type of *Tabaqa* property is integer.

Step 7: Creating Class Instances

The last step is creating instances (individuals) of classes in the hierarchy. The creation of individuals allows for all the properties of the classes to be recorded. The created individuals in the ontology represent the chosen sample of Hadiths used in the evaluation of the ontology (see Section 4). These individuals include Books, Hadiths, and Narrators as shown in Fig. 2.

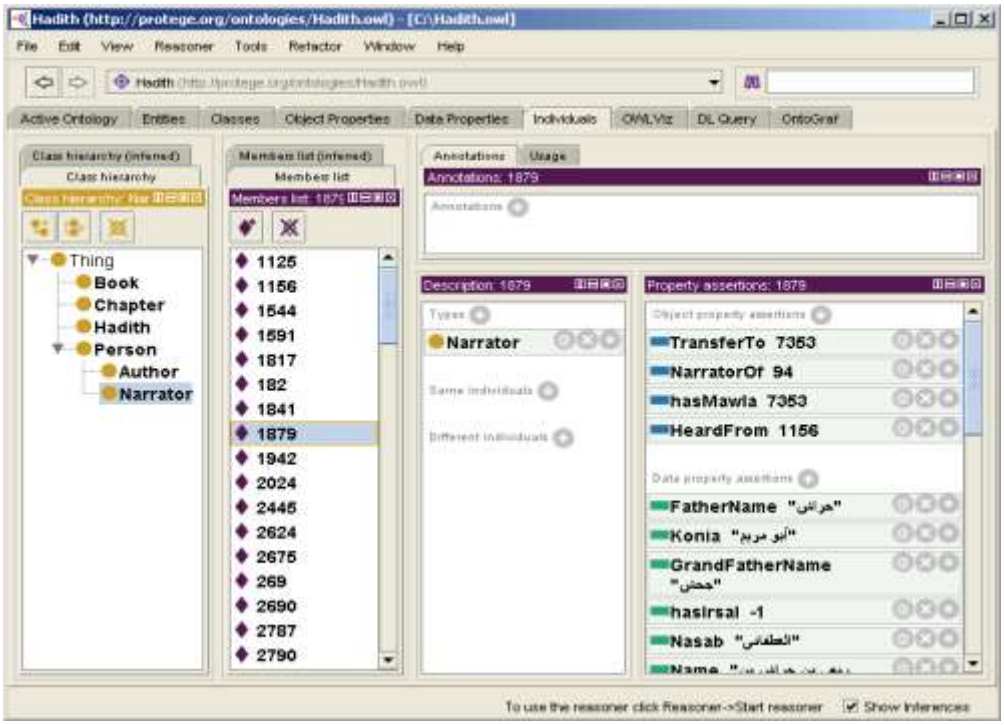

Fig. 2: Ontology Individuals

Fig. 2 shows Hadith Isnad Ontology instances (the individuals tab) in the Protégé ontology editor. It shows the class hierarchy, members list, object property, and data property. This information of individuals is based on the famous Hadith book of Ibn Hajar (2008 ،العسقلاني) . Ibn Hajar identifies each narrator using a unique identifier. We use the same identifier to identify each narrator as shown in the "Members list" of Fig. 2. Ibn Hajar identifies teachers and students of each narrator. In addition, he identifies the family relations between narrators. We use these relations in object properties such as *HeardFrom*, *TransferTo*, and *hasFather* properties.

Ibn Hajar identifies the *Rotba* of narrators using numeric values from 1 to 12, the *Tabaqa* of narrators using numeric values from 1 to 12, and the *Tadlees* of narrators using numeric values from 1 to 5. We use these values when inserting narrators' data properties. He also noted that a narrator might have *Ikhtilat*, *Irsal*, *Bida'a*, or *Wahem*. These data properties are represented in the ontology as follows: value "-1" is assigned if the narrator does not have any of these data properties *hasBedaa*, *hasIkthelat*, *hasIrsal* and *hasWahem*. Value "1" is assigned if the narrator has any of these properties. We refer to a Hadith that has any of these properties as *BedaaHadiths*, *WahemHadiths*, and *IkhtelatHadiths* object property.

4. Evaluating the Ontology

The evaluation of the quality of the ontology is an important part of its development. An ontology can be evaluated against many criteria: its coverage of a particular domain and the richness, complexity and granularity of that coverage; the specific use cases, scenarios, requirements, applications, data sources it was developed to address, formal properties such as the consistency and completeness of the ontology and the representation language in which

it is modeled (Obrst, Ceusters, Mani, Ray, & Smith, (2007) Brank, Grobelnik, & Mladenic, 2005 and Porzel & Malaka, 2004). We evaluate the quality of the created Hadith Isnad Ontology in representing all terms, properties, and relations through Hadith examples and ontology querying.

4.1. Evaluating Quality Through Hadith Example

We evaluate the quality of the ontology through a Hadith example to show if the ontology indeed represents terms, properties and relations needed in the given Hadith. The chosen Hadith is Hadith Number 6 in Sunnan Ibn Majah book. The Hadith in Arabic and English is as follows (The narrators in the Isnad are underlined):

6- حَدَّثَنَا مُحَمَّدُ بْنُ بَشَّارٍ حَدَّثَنَا مُحَمَّدُ بْنُ جَعْفَرٍ حَدَّثَنَا شُعْبَةَ عنْ مُعَاوِيَةَ بْنِ قُرَّةَ عَنْ أَبِيهِ قَالَ قَالَ رَسُولُ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ لَا تَزَالُ طَائِفَةٌ مِنْ أُمَّتِي مَنْصُورِينَ لَا يَضُرُّهُمْ مَنْ خَذَلَهُمْ حَتَّى تَقُومَ السَّاعَةُ.

It was narrated that Muhammad Ibn Bashar narrated to us Muhammad Ibn Jaafar narrated to us Shuba narrated to us Mu'awiyah Ibn Qurrah narrated that his father said: The Messenger of Allah (SAS) said: *"A group of my Ummah will continue to prevail and they will never be harmed by those who forsake them, until the Hour begins."*

Analyzing the Isnad of the above Hadith, we find that it contains the 5 narrators listed in Table 4 with their IDs as specified in the Hadith book of Ibn Hajar.

Table 4: Narrator of Hadith Number 6

No.	Narrator Name	ID
1	Muhammad Ibn Bashar "محمد بن بشار"	5754
2	Muhammad Ibn Jaafar "محمد بن جعفر"	5787
3	Shuba Ibn Al Hajaj "شعبة بن الحجاج"	2790
4	Mu'awiyah Ibn Qurrah "معاوية بن قرة"	6769
5	Qurrah Ibn Iyas "قرة بن إياس"	5537

Fig. 3 shows the extracted terms, properties, and relations of Hadith number 6 as they are represented in the ontology. The figure shows all classes of the ontology: *Book*, *Chapter*, *Hadith*, *Person*, *Author*, and *Narrator*. *Author* and *Narrator* are subclasses of *Person*. Based on the figure, the relation and properties are explained as follow:

Class *Book* has the individual Sunnan Ibn Majah. Sunnan Ibn Majah book has author (*hasAuthor* Property) Mohammed Ibn Yazed Ibn Majah. The book contains chapter (*hasChapter* Property) Introduction. The book contains Hadith number 6 (*ContainerOf* Property). Class *Chapter* has individual Introduction, chapter Introduction is a chapter of (*ChapterOf* Property) Sunnan Ibn Majah, and chapter Introduction contains Hadiths number 6 (*hasHadith* Property).

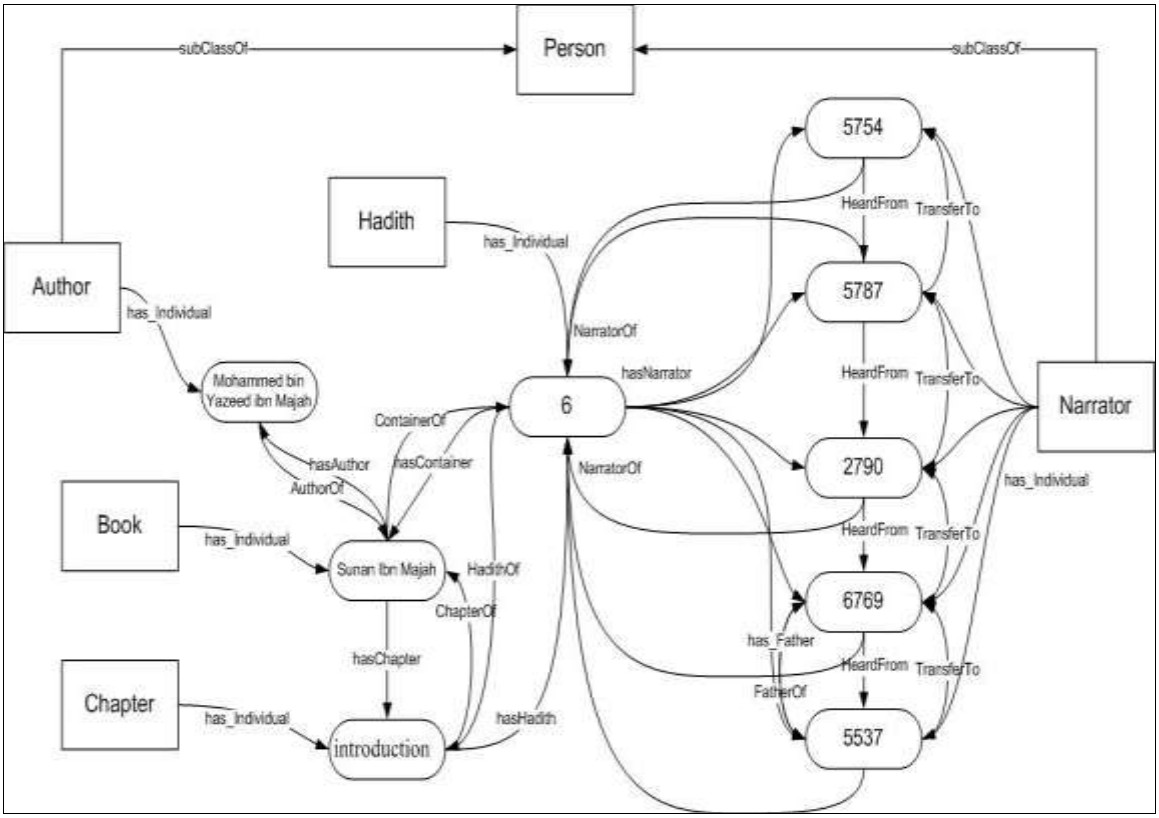

Fig. 3: Ontology representation of Hadith Number 6

Hadith Class has individual (*hasIndividual* Property) Hadith number 6 which is located in chapter 1 (the introduction) of the Sunnan Ibn Majah book (*HadithOf* Property). Hadith number 6 has several narrators (*hasNarrator* Property). Their *Id*s are: 5754, 5787, 2790, 6769, and 5537.

Class *Narrator* has individuals: 5754, 5787, 2790, 6769, and 5537. These numbers represent the identifier of narrators as identified by Ibn Hajar in his book (العسقلاني, 2008) as we explained earlier in Step 7 (Creating the Ontology Instances). Each narrator has heard from the next narrator (*HeardFrom* Property) and each narrator transfers to the previous narrator (*TransferTo* Property). All of these narrators have narrated Hadith number 6 (*NarratorOf* Property).

The ontology covers all needed narrators' properties: *Id*, *Name*, *FirstName*, *FatherName*, *FatherNickName*, *GrandFatherName*, *GrandFatherNickName*, *FourthName*, *FourthNickName*, *FifthName*, *FifthNickName*, *hasFather*, *Nasab*, *BirthYear*, *DeathYear*, *Gender*, *LiveIn*, *OriginallyFrom*, *DenotedBy*, *Konia*, *Luqab*, *Rotba*, *Tabaqa*, *Tadlees*, *hasBedaa*, *hasIkthelat*, *hasIrsaland* and *hasWahem* as shown in Table 3.

The example of Hadith number 6 shows that all elements of Hadith that are needed for judging Isnad are represented by the ontology. Upper level terms are set as classes, all properties of a narrator are set as object properties and data properties, and various attributes of Hadith are set as slots.

4.2. Evaluating Quality Through Ontology Querying

In order to verify and validate the ontology with regards to competency questions, we use the Description Logic Query (DL-Query) (Sirin & Parsia, 2007) via the standard Protégé plugin (Knublauch, Fergerson, Noy, & Musen, 2004) and it based on the Manchester OWL syntax (Horridge, Drummond, Goodwin, Rector, Stevens, & Wang, 2006). We used this Protégé DL-Query for querying the ontology and easily access narrators via their properties. Three querying function examples are presented below. They answer the main questions that are asked in the development process of the ontology.

Example 1:

- The question: Who are the teachers and students of Narrator with Id = 2445?
- DL-Query: Narrator and *HeardFrom* 2445 or *TransferTo* 2445.

The result of DL-Query in Protégé is shown in Fig. 4 which illustrates the individuals of Narrator class that are teachers and students of Narrator with Id = 2445.

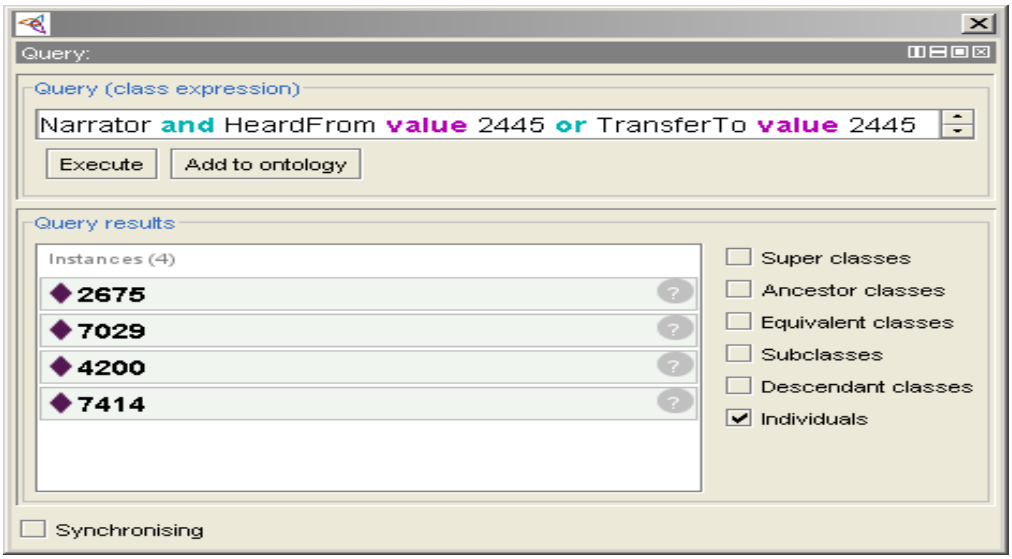

Fig. 4: Query for Teachers and Student of Narrator

Example 2:

- The question: who is the Narrator that has Konia Abu Al Azhar "أبو الأزهر"?
- DL-Query: Narrator and *Konia* value "أبو الأزهر".

The result of DL-Query in Protégé is shown in Fig. 5, which illustrates the individuals of Narrator class that has *Konia* "أبوالأزهر".

Fig. 5: Query and Result for the Narrator by Konia

Example 3:

- The question: who are the narrators of Hadith number 6?
- DL-Query: *Narrator* and *NarratossrOf* value 6.

The results of DL-Query in Protégé is shown in Fig. 6 which illustrates the individuals of Narrator class which are the narrators of Hadith number 6.

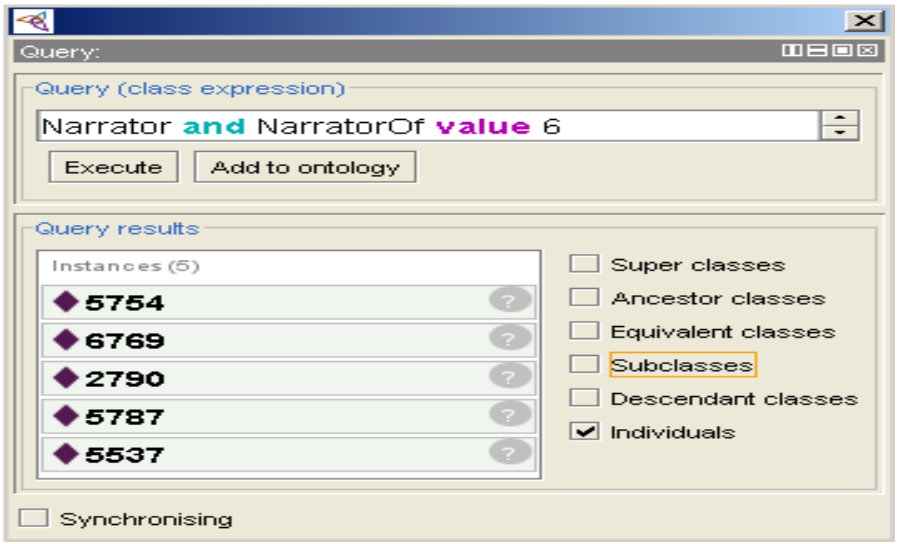

Fig. 6: Query the Narrators of Hadith Number 6.

The results of DL-Query examples show that the ontology successfully portrays the body of knowledge needed in judging Isnad. Querying shows that the Hadith Isnad Ontology provides the possibility for searching and manipulating data within the ontology.

The Ontology will be incorporated in an automated Hadith Isnad judgment system that would reveal and further test its usefulness and applicability in the Hadith judgment domain.

5. Discussion

The main contribution of this paper is the design of a comprehensive Hadith Isnad Ontology that would be employed in judging Isnad or in any Hadith related applications. The domain of the ontology (Hadith domain) is so rich of its concepts, properties, and relationships particularly when it comes to Isnad. The design of the ontology structured all Hadith concepts into a set of equivalent classes, properties, and relationships. Narrator is the main concept it represented since a narrator is the main constituent of Isnad. The ontology captured all the properties and relationships of a narrator as indicated and detailed in the various books of Hadith. Properties and relationships as presented in Section 3 steps 3 and 5 and Tables 2 and 3 include a narrator's personal information, family relations, his degree of authenticity (Rotba) among other narrators and condition-of-trouble (Tadlees, Ikthelat, Irsal, Bedaa, and Wahem). We evaluated the ontology through Hadith examples showing that indeed the ontology represents all necessary and relevant knowledge about narrators in a given Isnad. We also evaluated the ontology through DL-query examples to test its usability. The developed ontology will be the basis of a complete ontology-based Isnad judgment process.

The envisioned process would take a Hadith as input and separates its Matn from its Isnad. It would then build the tree of narrators contained in the Isnad and use the ontology to identify each narrator. The various naming manners of narrators such as first name alone, first name followed by father's name, and first name followed by father's name followed by grandfather's name and also similarity of names pose a challenge in identifying each narrator and separating him from the other narrators in the chain of Isnad. Next step in the process is to ensure the continuity of Isnad, i.e., connection of the narrators' chain. This would be performed using a reasoner. It checks whether each narrator has heard from his predecessor using ontology object properties such as HeardFrom, notHeardFrom and TransferTo. Then the process would use an algorithm that applies the judgment rules followed by hadith specialists to judge the authenticity of each narrator, his Rotba (rank) and condition-of-trouble based on the respective properties represented by the ontology. Finally the process ends by returning a decision weather a hadith is authentic or not and giving justification for the returned decision.

6. Conclusion

We presented the design and evaluation of a domain-specific ontology. The domain and scope of the ontology is Hadith and its Isnad. Hadith is oral traditions related to the words and deeds of Prophet Muhammad (SAS) and Isnad is the authentic chain of narrators through whom the narration has been transmitted. Hadith Isnad Ontology combines the ontology features with Hadith judgment rules (the clear steps Hadith scholars follow in the judgment of the Hadith Isnad) to identify the narrators so it can be used as the basis for the Isnad judgment process.

After building the Hadith Isnad Ontology, we evaluated its ability in representing all terms, properties and relations of a given Hadith. Additionally we queried the ontology through a number of DL-Query examples to ensure that it answers such questions that are

needed in the process of Isnad, i.e., identifying narrators and returning their needed information.

The developed Hadith Isnad Ontology can be used in a variety of ontology- and semantic-based systems. In our case it would be the basis for our next step which is building a comprehensive Hadith Isnad system that would combine the ontology with Hadith Isnad judgment rules and hence returns a decision weather a given Hadith is authentic or not and justifying the returned decision.

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