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A DYNAMIC ONTOLOGICAL FRAMEWORK FOR BUKHARI AHADITH

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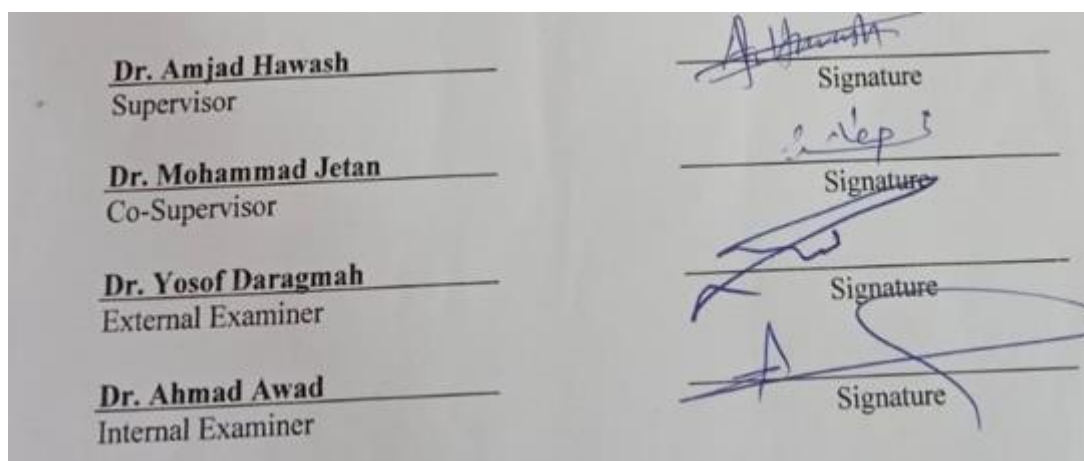
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Dedication

To my dear mother, from whom I learned steadfastness and love of life, no matter the difficulties ...

To the soul of my dear father, may Allah bless his soul ...

To those who encouraged me to continue my scientific career, my dear brother Ali ...

To my dear sisters who supported and encouraged me ...

To my friends and ambitious partners who supported me in every sense of the word ...

Acknowledgment

Thanks and praise be to God Almighty for giving me the strength and ability to complete this study ...

I also thank my family: my mother, my brother, my sisters for all that you do for me, your invitation, your patience, your motivation, your continuous support and encouragement to work on this thesis ...

I would like to thank my friends for their moral support during my study journey ...

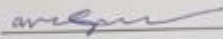
Finally, I would like to express my everlasting gratitude to my supervisors, Dr. Amjad Hawash and Dr. Mohamed Jetan, for their valuable time, patience and understanding. I would also like to thank them for the advice during the study period and their support for the general direction of this thesis, without the help, guidance and continuous follow-up from them. this search will not be ...

Declaration

I, the undersigned, declare that I submitted the thesis entitled:

A DYNAMIC ONTOLOGICAL FRAMEWORK FOR BUKHARI AHADITH

I declare that the work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's Name:	<u>Areej Sawwan</u>
Signature:	<u></u>
Date:	<u>23/02/2023</u>

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List of Terminology

Main Madar	He is the narrator from whom the chains of narrators are branched, and he has a direct relationship with source node.
Sub Madar	He is the narrator from whom the chains of narrators are branched and not directly relationship with source node.
Sheikh	He is the narrator, and he carried the news about him in the chain of narrators.
Student	He is the narrator who took from that Sheikh in the chain of narrators.
Tabaqa	Contemporary folk if they are similar in age and in the chain of narrator, “that is, taking from the sheikhs,” then it means the word “generation,” noting the participation in the teachers.
Itisal	By receiving each rawi to talk about those above it. Verifying the itisal of the chain of narrators requires knowledge of the forms on which the narration is carried by the student on the authority of the sheikh, through the forms of Tools (hear, narrate, told, Forebode, read on the sheikh) [1].
Inqitaa	By receiving each rawi to talk about those above it. Verifying the inqitaa of the chain of narrators requires knowledge of the forms on which the narration is accepted by the student on the authority of the Sheikh, through the forms of Tools (say, rawa, Thakar Fulan).
Musnad	It is what is related to its chain of narrators to the Prophet, may God bless him and grant him peace [2].
Moalaq	It is what has deleted the beginning of its chain of narrators, whether it is one or more that was deleted, as Al-Bukhari said [3].
Narrator Rank	In terms of the two attributes of justice and restraint being established in them (at-ta’deel), or in terms of their lack of them (al-jarh).

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Abstract

The honorable Sunnah is the second source of Islamic legislation after the Holy Qur'an. Muslim scholars have been interested in preserving and codifying the *hadith* because of its role in the statement of the Holy Qur'an by allocating the general, restricting the absolute, and clarifying the total. The Prophet's Sunnah was transmitted orally with *isnad* (Isnad, from Arabic "sanad" (support), in Islam, a list of authorities who have transmitted a report (hadith) of Prophet Mohammad (PBUH) or his companions. Its reliability determines the validity of a hadith), which are the most dominant, and in writing for those who mastered writing in the time of the Prophet and the Companions, then it was written down and the hadiths were compiled with their chains of narrators until today they became Resources books of *hadith* (hadith, everything that was narrated from the Prophet Muhammad (PBUH) in terms of saying, acting, or reporting), Mustadrakat and other books that specialize in collecting and classifying hadiths. Enriching Islamic electronic content is a great challenge for researchers. Although Arabic is a global language and ranks as the sixth most used language around the world and is spoken by more than 400 million people, it does not have a sufficient presence on the internet, compared to other languages.

Ontology is defined as a knowledge representation way, and it is data model that reflects a set of concepts inside a domain and the relationships between those concepts.

This study aimed to build a dynamic ontological framework through which specialists in *hadith* science will be able to provide sufficient information about *hadith*, so that the ontology is able to save *hadith*, taking into account linking it with the relevant hadiths and narrators present in the framework, which makes the process of retrieval of information easy and fruitful. The study was conducted on the "Ablution Book" from Sahih Al-Bukhari. The researcher evaluated the system by executing several queries

about narrators, hadiths, and the chain of *isnad*, and when comparing the results of the system with the traditional results and other ways of knowledge representation, the outcome was much better in search, retrieval, or in drawing *hadith isnad* trees, or in execution time in searching for information.

Keywords: *Hadith*, *Hadith isnad* tree, Knowledge representation, Ontology, Dynamic Ontological Framework.

Chapter One

Introduction

1.1 Overview

Extracting knowledge from unstructured historical data is considered a challenge and a hot topic in the computer science field. Several NLP (Natural Language Processing) techniques were invented to enhance knowledge extraction. Arabic, as a universal language, is considered a rich source of historical documents. Holy Quran and Prophet Mohammad (PBUH¹) talks (Ahadith) are two major sources of Arabic historical data that encourage NLP-related research to be conducted. Choosing the suitable structure of Ahadith enhances their knowledge extraction. Extracting knowledge from unstructured texts is an error-prone process due to the scattered information that exists. Ontologies, as techniques of converting unstructured data to structured ones, are getting famous due to their variety and wide usage in NLP-related works. This work is related to building an ontological-based framework for Ahadith so that conducting NLP-related research to extract knowledge from them becomes easier and more fruitful. The ontological framework enhances the knowledge extraction that could be related to: historical events, people, Islamic-related issues, and others. Moreover, different ontological centrality measures can be executed such as closeness, betweenness, discovering colonies of related data, eigenvalues, and others.

1.1.1 Hadith definition

Hadith (الحديث النبوي): Everything that was narrated from the Prophet Muhammad (PBUH) in terms of saying, acting, or reporting [4]. And it consists of two parts, the sanad (السند), and the matan (المتن).

Sanad: It is the path of the Matan, which is the chain of narrators (الرواة) who narrated the matan from its first source [5]. Matan: It is the words of the hadith that carry their meanings, which is what the sanad ends with [6].

¹ Peace Be Upon Him

1.1.2 Ontology

In computer science, we can define ontology as a data model representing knowledge as a set of classes and relations between them within a particular domain [٢٦]. The representation of knowledge within a particular field is the primary goal of ontology, and one of the benefits of using ontology is the possibility of representing any type of data, whether it is structured, semi-structured, or unstructured, which allows data integration, extracting concepts and texts easier, and data-based analytics. In addition, it is easy to expand the ontology, whether by adding relationships or concepts. Another advantage is the ability to share information between systems in the same field, by standardizing terminology, which increases the system's flexibility and allows for rapid application development [27]. Applications of Ontologies: Natural Language Processing, Artificial intelligence, Semantic web, Electronic health records, Biomedical Informatics, and Library science.

1.1.3 The importance of hadith

We can summarize the importance of Ahadith² in [7]:

- An important source of legislation in Islam, which scholars and jurists rely heavily on in order to devise provisions that are an essential reference for people in their behavior and dealings.
- Interpretation and clarification of many of the provisions that were originally unexplained in the Holy Quran.
- Introducing the characteristics of the Messenger, may God's prayers and peace be upon him, and an explanation of his life (PBUH) and how he dealt with his family and neighbors.
- One of the ways of telling the unseen, in which belief is part of the Islamic faith.

1.1.4 Ablution definition in the Arabic language

The word ablution (الوضوء) in the Arabic language is a name for the verb, that is, the use of water in specific parts, which is what is meant here, taken from ablution, goodness, and cleanliness [8].

² The arabic plural of Hadith

1.1.5 Ablution in Islamic sharia

It is defined in Sharia³ as specific cleanliness, or it is specific actions that open with intention. It is washing the face, hands, and feet, and wiping the head. The clearest definition of it is: It is the use of purifying water in the four parts (i.e. the former) according to a specific characteristic in the Sharia [9]. The reason why ablution is obligatory: It is the event, the beginning of the time for prayer, standing up to it, and the like. As for the conditions for ablution, they are two types:

- Conditions of obligation: They are if they meet the obligation of purification on a person.
- Conditions of validity: What is not valid purity without it.

1.1.6 The importance of Ablution

Ablution is considered one of the acts of worship in Islamic law, and this worship has the importance of being a basic reason for the validity of prayer, as prayer is the second pillar of Islam and the first thing that a person will be held accountable for on the Day of Resurrection, and it is a spiritual link between a person and God Almighty [10].

1.2 Problem Statement

The problem of this research is to build a automated dynamic ontological framework for input Ahadith and Ruwah (رواة الأحاديث)⁴ and connected it with suitable links with other links with other related Ahadith.

1.3 Significance of the study

In the following section, we are presenting the aim of the study as well as the importance of creating a dynamic ontological framework for Ahadith related to Ablution.

1.3.1 Main importance

Ahadith study-related scholars (المختصون بعلم الحديث) will be able to support the framework with Ahadith sufficient information in which the framework is able to save these Ahadith

³ Sharia acts as a code for living that all Muslims should adhere to, including prayers, fasting, and donations to the poor

⁴ The Arabic plural of Rawi (narrator)

in the ontology taking into account connecting the inserted Ahadith with the related Ahadith and Ruwah already exist in the ontology in a way making the information retrieval from the ontology be easy and fruitful.

1.4 Aim and specific objectives

The aim of this study is to build an ontological-based framework for Ahadith (Sanad, Matan). Since there are many difficulties related to coping with all Ahadith and their relations, we are focusing on the ones related to the topic of ablution as a sample ontology framework with the ability to tune the structure in order to add additional Ahadith related to all Islamic topics appear in Al-Bukhari Ahadith book.

We can summarize the specific objectives as follows:

- Collecting all ablution-related hadiths, studying hadith science and identifying new meanings through relationships between them. Clarification of some matters related to the science of Isnad and Matan (How to split hadith to Isnad and Matan, mechanism to create Isnad graph tree, extract relationship from matan topic).
- Implementing the prototype by using ontology.
- Evaluating the prototype according to chosen evaluation strategy.

1.5 Scope and Restrictions

- Ontology domain is the Al-Bukhari Ahadith.
- The research focuses on the Ahadith of ablution.
- The narrator's information are been taken from The great history (Bukhari), aljarh w alta'deel (الجرح والتعديل) (Abdelrahman Ibn Abi Hatem), tahdhib altahdhib (تهذيب التهذيب), tahdhib al kamal (تهذيب الكمال).
- All the explanations and definitions related to ablution and Islamic law were taken from Islamic jurisprudence and its evidence, the Kuwaiti Fiqh Encyclopedia (موسوعة الفقه الكويتية), and the critical approach.

1.6 Methodology

The methodology used to achieve the objectives of this research is outlined in:

- **Research and study:** Study and analysis Ahadith in Ablution section, review of previous studies and works related to the field of Islamic ontology.
- **Data Processing:** Studying Ahadith to extract the needed components for build the ontology.
- **Ontology Building:** Use graph development process and tools like: *Neo4j*, *python* and *MySQL* includes the following tasks:
 1. Determine the domain of the ontology.
 2. Pre-processing of the corpus.
 3. Enumerate the important concepts in the ontology.
 4. Define classes and class hierarchy of the ontology.
 5. Define the properties of classes (slots).
 6. Define the facets (role restrictions) of the slots.
 7. Create the instances.
- **Developing a prototype of the proposed approach:** Using Python, web Service and Neo4j, the development steps as following:
 1. Design.
 2. Implementing.
 3. Testing.
- **Evaluating the prototype:** Conducting a number of experiments to evaluate the performance of the approach by applying several criteria by entering the Ahadith and comparing the results with the results of experts in this field.

1.7 Thesis Structure

- **Chapter 1 (Introduction):** This section contains a foreword to the problem of extracting useful information from the Ahadith and our proposed solution represented in conducting a dynamic ontological framework related to Ablution Ahadith.
- **Chapter 2 (Related Works):** Present the related works on constructing on tologies as well as the previous works of conducting Ahadith ontologies and the different methodologies related to this topic.

- **Chapter 3 (Theoretical Background):** Describe the theoretical foundations required for thesis work, Hadith Science, Isnad and Matan importance, Hadith Isnad tree, Knowledge Representation definition, importance, and ways.
- **Chapter 4 (Ontology):** Provides an explanation of the ontology, including its definition, ontology engineering, ontology development, ontology evaluation, and ontology tool.
- **Chapter 5 (Methodology):** Display steps for building the prototype, system architecture, implementation, and how they interact with each other to accomplish the tasks.
- **Chapter 6 (Adding Hadith (Ontology Expansion)):** Display the prototype working mechanism, and it includes several steps, beginning with entering the narrators information and ending with adding the hadith to the dynamic ontology framework.
- **Chapter 7 (Experiments and Results):** Explain how the prototype was evaluated using experiment and evaluative metrics then discuss the results.
- **Chapter 8 (Conclusion and Future Work):** Talks about the conclusion and presents planned future works.

Chapter Two

Related Works

This chapter includes the works related to the field of this thesis. Most of the literature that was focused on in this chapter is related to ontology in the field of research related to the sciences of the Prophetic hadith, the science of isnad, the Arabic language, information retrieval, and the basic concept of ontology. These works can be classified as follows:

2.1 Hadith Encyclopedia

Many encyclopedias are available to help in researching and studying hadith, following the conditions of narrators, and drawing the isnad tree. Such as:

- Alshamela, Encyclopedia of narrators of hadith.
- Encyclopedia of Ahadith: Its goal is to provide simplified and clear explanations of the correct Prophetic Ahadith and translate them accurately and with high quality into other languages.
- ALdorar ALsaniyyah (الدرر السنية): Website in the various alshareia sciences: (tafsir (التفسير), hadith, aqidah (العقيدة), fiqh (الفقه), and other sciences).

2.2 Arabic and Islamic Ontology Development

The work presented in [28] aims to develop ontology Hadith system, which is an ontology based system that improves the zakat Ahadith retrieval process by using semantic tools rather than keyword exact matching. In addition to the knowledge base that contained the Ahadith associated with the zakat topics as instances of the ontology, the system included all zakat topics and their relationships.

Another study the researchers proposed to create an ontology of hadith sciences in Arabic, knowledge was collected from various sources such as hadith books and hadith experts, as for the main goal is to improve the process of information retrieval and knowledge extraction, the ontology can be used in various fields such as document indexing system, hadith classification and hadith evaluation [29].

Another work was to develop a prototype application for utilization of the proposed ontology, the ontology was developed using the Prote´ge´ tool, and the ontology consists of 113 concepts and 85 properties, the proposed tool can be helpful for interested people to better understand the details about praying [30].

The research published in [31] implemented the ontology used to create an Islamic ontology covering the Holy Qur’an and the Noble Hadith, it compares the keywords extracted from the titles of Sahih Al-Bukhari and the concepts of the Qur’anic ontology, this provides a visualization of the interactions between the words of the Ahadith of the Prophet and the Qur’anic concepts.

2.3 Hadith Ontology

The work proposed put forth a brand-new Sanad Hadith representation approach that makes use of the Graph model. First, Arabic Named Entity Recognition (A-NER) and Arabic Part of Speech (A-POS) were used to automatically extract the candidate for a graph node and a graph relation from the raw Arabic Hadith text. Then, using the SVM and GBM algorithms, a novel machine learning model for the Hadith Sanad Graph Construction was created [32].

The work published was related to building Hadith Isnad Ontology, a domain-specific ontology, is used to support the process of authenticating and evaluating isnad through hadith examples and DL-Queries (Description Logics) [33].

While the aim of the published study in [34] sought to create an ontology-based Arabic text, and more especially, an ontology that embodies the original Hadith text's semantics, a completely manual process was followed to ensure the correctness of the results. The proposed ontology is implemented with the ontology diagram Editor “Prote´ge´ version 4.3”.

In this research we developed automated build process for dynamic ontological framework for Ahadith and Ruwah input, and the framework is able to save these Ahadith and Ruwah in the ontology and connect it with suitable links with other related Ahadith previously exist in ontology.

Chapter Three

Theoretical Background

We are delivering the fundamental concepts and technical knowledge that serve as the foundation for comprehending the thesis in this chapter.

3.1 Hadith Science

The science of hadith in language means the awareness of speech; That is, an understanding of hadith and familiarity with all its details [11]; and the science of hadith idiomatically means: **the knowledge by which the conditions of the narrator are known in terms of acceptance or response** [12]. The process of transcribing the hadith of the Prophet passed through two main stages:

- **Prohibition:** for fear of mixing the process of transcribing the Qur'an with Ahadith.
- **Real codification:** which began for fear of losing knowledge by the disappearance of Ahadith in which some of the existence of false Ahadith has been noticed by scholars.

Encyclopedias of Ahadith began to appear in the middle of the second century of the Hijri timing⁵ and were the fruit of the efforts of scholars who gave their lives for the sake of knowledge and the journey of seeking knowledge where these encyclopedias differed in their writing styles [13]. Among the most famous are Sahih Al-Muslim (صحيح مسلم) and Sahih Al-Bukhari (صحيح بخاري) which will be our reference in this study).

Al-Bukhari⁶ is one of the scientists who worked on collecting and organizing the prophet Mohammad (PBUH) Ahadith. His book titled with "*al-Jami' al-Musnad al-Sahih al-Mukhtasar min umur Rasul Allah wa sunnanihi wa ayyamihi*" (The abridged collection of sound reports with chains of narration going back all the way to the Prophet regarding matters pertaining to the Prophet, his practices and his times.), also known as "**Sahih al-Bukhari**" is the most famous work related to prophet Mohammad (PBUH) Ahadith collection. This book is considered the main source of Arabic historical data used in several works related to knowledge extraction. In his book, Al-Bukhari collected around

⁵ This timing began when prophet Mohammad PBUH traveled from Makkah to Madinah

⁶ <https://www.britannica.com/biography/al-Bukhari>

7,397 correct Ahadith and used to categorize them according to several subjects related to almost all aspects of life in offering accurate direction for Islam such as the method of performing prayers, fasting, pilgrimage, purity, and other actions of worship directly from the Prophet Muhammad (PBUH). Al-Bukhari used to travel and visit several locations to collect Ahadith from persons who have some links with others till the reach of the prophet Mohammad (PBUH). Figure 3.1 shows the travels done by Al-Bukhari for Ahadith studying and documenting.

Figure 3.1

Al-Bukhari's travels seeking and studying Ahadith



Note: Commons W. None, editor. Al-Bukhari's travels seeking and studying Ahadith. None; 2017. File: /BukhariTripEnglish.jpg. Available from: <https://2u.pw/nm2IYOA>

According to Hasan and Yahya (2014), oral Ahadith were not dominant in the early years of Islam, some concerned people used to write down the prophet Mohammad (PBUH) Ahadith. But, over time circumstances have changed, and traditionalists feel that oral Hadith began to lose its popularity for political, religious, and social reasons. The need to protect Ahadith was raised as a priority and the demand to face false Ahadith. The question is **“Was Islamic methodology in general and Hadith in particular scientific in the contemporary research measures?”**. The work of Hasan and Yahya (2014) is

related to answering this question. The authors of the work discuss the different ways of scientific approaches and concluded that the early Islamic methodologies are scientific in the sense of collecting data methods used by Al-Bukhari and others. However, they listed the different stages of Ahadith narration that ended with Al-Bukhari work: (1) The companions who got Ahadith directly from prophet Mohammad (PBUH); (2) Quran was the method of decision and Ahadith got a wide reputation after the death of the prophet; (3) Writing Ahadith became common in restored and public centers and writing Ahadith became usual by some Ahadith collectors like Imam Malik and Hanbal; (4) This stage had the emergence of classifications for Ahadith according to subjects; (5) Here comes the work of Al-Bukhari in collecting Ahadith and classifying it according to their degree of correctness. The reader can return to the work of Hasan and Yahya (2014) to have a clear idea about the scientific approach of Al-Bukhari.

3.1.1 The importance of Matan

The matan text contains the core and the essence of hadith, it is what the prophet Mohammad (PBUH) exactly talked about. However, the correctness of matan is much related to the correctness agreed chain of narrators, that is the sanad since any matan without a sanad is considered doubtful from the point view of Ahadith collectors [14].

3.1.2 The importance of Sanad

Studying the chain of narrators to know the conditions of the narrators who narrated a given hadith through the science of jarh (الجرح) and ta'deel (التعديل), and to judge whether the hadith is continuous (متصل), interrupted (منقطع), or mursal (مرسل) and preserving the Sunnah (السنة) of the Prophet from distortion, addition, and subtraction [15].

The term "Al-Jarh" can be defined as: "The perfect narrator refuting the narrator's narration for a defective reason in it or in his/her narration, such as immorality, fraud, lying, perversion, or the like". While the term "ta'deel": "Describes the narrator with something that requires the acceptance of his narration". As for the science of jarh and ta'deel: It is a science in which narrators are investigated and modified with specific words and the ranks of those words, and this science is one of the branches of the science of hadith men [16].

It is worth mentioning the clarification of some of the terms of the hadith sciences, mursal what the sahabe omitted from, and with a more accurate definition is what the tabee or the sahabe who did not hear from the prophet, may God bless him and Peace be upon him. Interrupted What deleted the first chain of narrators [17]. And continuous hadith: It is the hadith whose chain of narrators is linked to taking each narrator from those above him from its beginning to its end [18].

3.1.3 Hadith Isnad tree

Hadith Isnad tree (شجرة اسناد الحديث) it is one of the branches in hadith science, which is concerned with the study of the hadith chain of narrators, and it is a graph that clarifies the methods of the hadith and shows the narrators and their ranks (رتبة الرواة). And it plays a major role for researchers in studying hadith more clearly and accurate way to judge the narrators and Ahadith [19]. Steps of Studying hadith and Draw Tree:

Step 1: Choose Ahadith.

In this step, the user will choose the Prophet's Hadith from Sahih Al-Bukhari, specifically from the Book of Ablution.

Hadith = Sanad + Matan.

Step 2 : Sanad – Matan Separation.

As we mentioned earlier, Sanad is the series of narrators who narrated the text and transmitted it from the first source, Matan is the hadith text which comes after the Sanad.

Sanad = Format + Narrator Name + Format + Narrator Name + ... + Source.

At this step, we will determine the end of the prophet's Sanad hadith and the beginning of the Matan. By studying the mechanism of writing the Sanad in Sahih Bukhari, we noticed that there are several rules to determine the end of the Sanad. And these rules are [20]:

- Most Ahadith begin with say statement the Prophet peace be upon him, as the Messenger of God said.

- The Sanad ends with one of the companions or followers, may God be pleased with them.
- The wives of the Prophet (PBUH) also narrated the prophetic Ahadith about him, and his wife Aisha is the only one of his wives who narrated the Ahadith. There are several formulas indicating the end of the Sanad, including:

1. The mother of believers.

2. Wife of Prophet Mohammad (PBUH).

- There are Ahadith that do not refer to the saying statement of the Prophet, peace be upon him, but about stories that happened with people or with narrators during the life of the Prophet, and these Ahadith begin with a verb, like someone who asked, look, did.

Step 3: Narrators Separation.

At this step, we're going to separate each narrator from the other. The Sanad often consists of a phrase (Format) (صيغ الإخبار) such as (he said, tell, tell us) followed by the name of the narrator followed by a phrase followed by a narrator, and so on until it ends with a form of followed by the Messenger of God.

These phrases will be considered relationships between nodes, that describe the kind of relation between Ruwah. The following list contains all of such phrases: [21].

- Heard From (I heard, he heard). سمعت عن أو سمع عن
- Transfer To (he told us, she told him, he told me, he told him, he told both of them, he told them, he told me). أخبرنا أو أخبرته أو خبرني أو أخبره أو أخبرهما أو أخبرهم أو أخبرني
- Has Narrator (narrated us, he is narrating, she narrated me, he narrated him, he narrated me, he narrated). حدثنا أو يحدث أو حدثتني أو حدثته أو حدثني أو حدث
- Forebode (he foreboded us, he foreboded me). أنبأنا أو أنبأني
- Ask (I ask). أسأل
- Proposition (it's a, that, from). أنه أو أن أو عن
- Say. قال
- Write. كتب

- Read on Sheikh. قراءة على الشيخ
- Thakar Fulan. ذكر فلان
- Rawa. روى

Step 4: Extracts Narrators (Rawi) Name.

Here we're going to extract the names of the Narrators who represent the nodes of the Graph database, in addition, to identifying the Source node (Prophet Mohammad "PBUH") and the Sink node (Al-Bukhari).

Each narrators node has attributes (Tarjamet Alrawi)which includes a brief about the life of the narrator, his name, place of birth, place of death, date of birth, date of death, qunia and balad [22].

Step 5: Narrators chain processing.

In some Ahadith, the Arabic letter (ح), (قالا) marks the beginning of a new Isnad chain. This is a very common Hadith notation and is widely used in the Sahih of Bukhari.

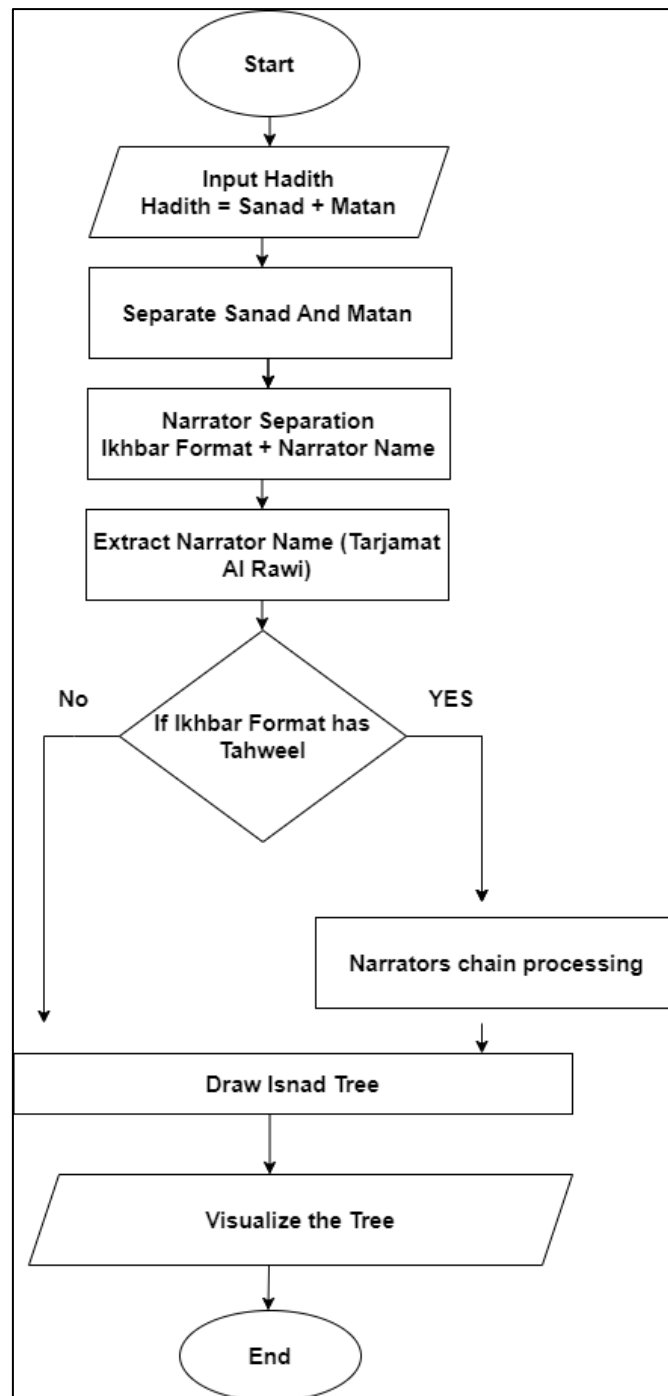
Step 6: Draw Isnad Tree.

Which consists of the nodes (narrators, matan, bab, kitab, source, and sink) and the relationships between them, starting from the source node and then the chain of narrators until to sink.

Figure 3.2 shows the flowchart of studying hadith.

Figure 3.2

Studying hadith flowchart



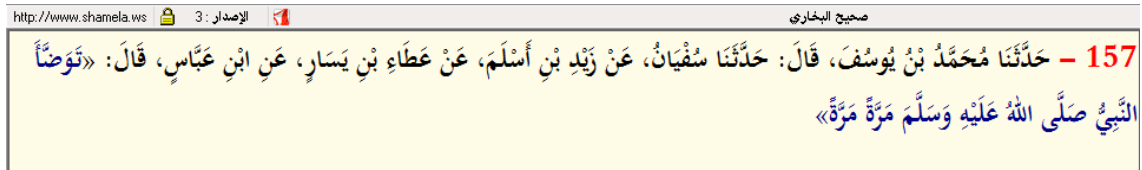
And as an illustrative example for studying hadith and Draw Tree:

Step 1: Choose Ahadith:

We choose Hadith No. 157, bab “باب الوضوء مرة مرة” as in Figure 3.3

Figure 3.3

Hadith No. 157 from ablution kitab



Step 2: Sanad – Matan Separation: Sanad :

حدثنا محمد بن يوسف، قال : حدثنا سفيان، عن زيد بن أسلم، عن عطاء بن يسار، عن ابن عباس، قال

Matan:

"توضأ النبي صلى الله عليه وسلم مرة مرة "

Step 3: Narrators Separation:

The Ikhbar Format contained in this hadith is as follows:

-حدث

- حدث

- عن

- عن

- عن

Step 4: Extracts Narrators (Rawi) Name:

Table 3.1 display the narrator's name and first name according to Tarjamat Al-rawi.

Table 3.1

Extract narrators (Rawi) name from the sanad

Narrator	First Name
محمد بن يوسف	محمد
سفيان	سفيان
زيد بن اسلم	زيد
عطاء بن يسار	عطاء
ابن عباس	عبد الله

Step 5: Narrators chain processing:

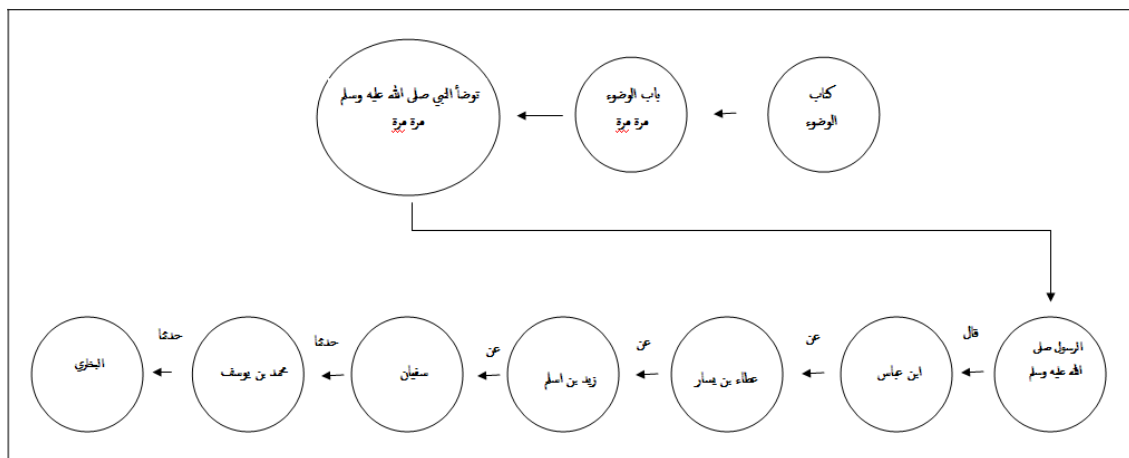
The sanad of this hadith does not contain the special case of format like *ح, قالا*, so there is no need to process the chain of narrators.

Step 6: Draw Isnad Tree:

Figure 3.4 shows isnad tree for hadith no. 157.

Figure 3.4

Isnad tree visualization



3.2 Knowledge Representation

Compared to machines, humans are the best at understanding, reasoning, and interpreting knowledge, and accordingly they can perform various tasks in the world.

3.2.1 Definition

Since artificial intelligence strives to make the machine intelligent by performing tasks to achieve the desired goal. Knowledge representation has become one of the areas of great interest in artificial intelligence. And we can define it as the representation of information from the real world in order for the computer to understand it and then use it to solve real-life problems, and it does not depend on storing data, but rather allows the machine to learn from that knowledge and act intelligently like humans [36].

3.2.2 Importance

A machine is capable of understanding some concepts (such as people, language and academic disciplines) at a high level, while there are strange concepts like intentions and

intuitions which could not understand them. And the knowledge representation makes the machine capable of this and enables the intelligent system to make the appropriate decision and action.

As well as providing factual information in a way that a computer can understand and use to solve real-life problems. Briefly, it enables a machine to learn from knowledge in order to operate with human intelligence.

3.2.3 Ways Of Knowledge Representation

We can represent knowledge in several ways, the most important can be mentioned as follows:

1. Logic:

It is the basic form of representing knowledge, and by it, we mean drawing a conclusion based on different conditions, and it consists of syntax and specific semantics that supports inference. This type is characterized as the basis of programming languages, and through which logical thinking can be done [37].

2. Object Oriented:

In the traditional models, programs consist of variables and functions that take those variables as arguments and are considered new variables, but the new programs consist of self contained objects that combine variables and functions that deal with them and the behavior of the object is included without the need to pass it as a variable to the function.

The main idea of the object oriented approach is to represent knowledge about a domain in terms of objects, classes, and the relationships between them.

In the knowledge representation using an object-oriented approach, a system is considered as a set of related objects, each encapsulating with attributes and processing associated with the attributes. Communication between objects is carried out only by messages, and the object is called when a message is received [38].

3. Ontological:

In this way of knowledge representation, ontology is considered a data model that depicts a group of concepts from a particular domain together with the relationships between those concepts.

It has a great role in knowledge representation as it is simple and easy to understand and implement, in addition to being a method that organizes concepts systematically [39].

4. Taxonomy:

A taxonomy is a hierarchical framework, or schema, for the classification of different types of living things as well as inanimate objects, occasions, and/or ideas. As humans, we encounter taxonomies frequently but rarely give them much thought. The facets, filters, and search suggestions you frequently encounter on contemporary websites are called taxonomies [40].

5. Semantic Network:

A semantic network is a method of knowledge organization and storage used in artificial intelligence. Semantic networks are a sort of graphic representation that makes it simple for people to understand the connections between concepts, ideas, and things. A semantic network's nodes are concepts, and its edges show how those concepts are related to one another. Semantic networks are simple to comprehend and may be expanded with ease.

The two basic types of relations in this representation are:

- a. IS-A relation (Inheritance).
- b. Kind-of-relation.

The use of a semantic network in AI has numerous advantages. It can be beneficial to:

- a. To arrange and structure knowledge in a way that is simple for machine to comprehend.
- b. It can offer a means of representing intricate connections between ideas in a way that people can easily comprehend.
- c. By offering a more effective way to describe knowledge, it can aid in enhancing the performance of AI systems.

The use of semantic networks in AI comes with a few difficulties. They can be challenging to make, which is one difficulty. These can be challenging to interpret, which is another difficulty. They might also be expensive computationally.

Ontologies and taxonomies are comparable in many ways since they both explain different categories of items and are set up in a hierarchy.

A taxonomy is comparable to a tree, whereas an ontology is more like a forest, metaphorically speaking, to put it another way, ontologies allow for far more sophisticated linkages, such as “has-a”- and “use-a”-relations, whereas taxonomies describe a collection of subjects with “is-a”-relationships.

Ontology is the more comprehensive, all-encompassing phrase, whereas a semantic network is a more focused method of information representation. The links between the items in a semantic network only represent binary relations, which is one of its limitations. For example, the sentence: Run (RajdhaniExpress, Chandigarh, delhi, Tomorrow) cannot be directly affirmed.

Semantic networks take more computation time during runtime since we have to go through the complete network tree to locate some solutions. In the worst case, after searching the entire tree, we can find that the solution does not exist in this network.

Chapter Four

Ontology

During this chapter we will cover the definition of ontology, ontology engineering, development steps, and tools we can use.

4.1 Introduction

An ontology in computer science is a data model that reflects a set of concepts inside a domain and the relationships between those concepts, and it derives from philosophy. For example, in artificial intelligence, software engineering, biomedical informatics, and information architecture, ontology is referred to as a type of knowledge representation about the outside world. In computer science, ontologies typically describe as $\text{Ontology} = (C, R, F, I, A)$, where [41]:

1. **Classes:** the basic elements of the domain.
2. **Relationship:** ways that objects can be related to one another.
3. **Functions:** the changing of attributes or relations.
4. **Individuals:** the basic or “ground level” objects.
5. **Axioms:** attributes properties, features, characteristics, or parameters that objects can have and share.

4.2 Ontology Engineering

It refers to a set of interrelated tasks concerned with the life cycle of the ontology and its development in a specific field, in addition to the methodologies, tools, and languages that will be used to build it.

There is no one correct methodology for ontology development and it is usually an iterative process, starting from the initial ontology and then reviewing and improving it. As we mentioned earlier that ontology is a model of a real field in the world, and the concepts in it reflect reality. And we can evaluate the initial version of the ontology by discussing it with experts in the specific field [42].

4.3 Ontology Development

The basic principles of ontology development are: [43]

- No single ideal approach to modeling a domain.
- The process of developing an ontology is iterative.
- “Concepts should be close to objects and relationships in the domain”.

The general steps in the design and development of ontology:

Step 1: **Determining the Domain and Scope of the Ontology.**

This stage begins with defining the domain and scope of the ontology by answering several questions called competency questions, which are: What is the domain that the ontology will cover? For what (or how) are we going to use the ontology? Who else will use the ontology? Source of knowledge, and Scope?

Step 2: **Consider Reusing Existing Ontologies.**

Here, we make sure that there is a previous ontology in the same field. If there is a previous ontology, it is easy to import and modify it instead of creating it from scratch.

Step 3: **Enumerating the Important Terms in the Ontology.**

The goal of this step is to list all the terms that we want to use and explain them to the users. What terms would you like to talk about? What are the characteristics (properties) of these terms? What needs be said regarding these terms?

Step 4: **Defining the Classes and the Class Hierarchy.**

There are several possible approaches to developing a class hierarchy such as top-down, bottom-up, and combination. In the top-down development process define general concepts first, then define specializations. In the bottom-up define specific categories first and then group them into more general concepts. In combination first, identify the most obvious concepts, then generalize and specialize them.

Step 5: Defining the Properties of Classes (Slots).

After defining the classes, we describe the internal structure (properties) for concepts, an object property becomes a slot for this class.

Step 6: Defining the Facets of the Slots.

In this step, we set restrictions on the slot by defining the facets, including the data type, acceptable values, the cardinality of the property, and another attribute.

Step 7: Creating Instances.

This step adds instances of classes into the ontology, for each instance, we define its name, and description, to which any concept belongs and its value.

4.4 Ontology Evaluation

We can define ontology evaluation as the task of measuring the quality of the ontology, and the process of evaluating it's important part for ontology development. Ontology can be evaluated from two key perspective, which are quality and correctness. These two perspectives dealt with several criteria: [44]

- Accuracy: A measure that checks how close the test results (query) are to the real results.
- Completeness: A criterion that checks whether the domain of ontology is completely covered.
- Conciseness: Measures whether the ontology includes irrelevant elements in relation to the domain to be covered.
- Adaptability: Measures how far the ontology anticipates its use.
- Clarity: Measures the effectiveness of the ontology in communicating terms with their intended meaning.
- Computational efficiency: The ability of the tools used to work with the ontology, the most important of which is the speed to complete the required tasks.
- Consistency: Ensure that the ontology does not include or allow any inconsistencies.
- Scalability: The ability to add new information sources without having to make significant changes to the integrated system's ontological components.

4.5 Ontology Tool

The graph database stores nodes and relationships instead of tables and documents, which is a flexible method of use that allows storing data without having to limit it to a pre-defined form. Graphs contain nodes (are the entities in the graph), Relationships (provide directed, named, connections between two node entities), and properties, all of which are used to represent and store data in a way that relational databases are not equipped to do.

Neo4j, As a tool that gives developers and data scientists reliable and advanced tools for building smart applications, currently in version 4.4, is an open source, scalable graph database implemented often in Scala. Cypher, an ASCII art, high abstraction, and declarative sublanguage, is the primary method for querying graphs. Cypher APIs for Python, Java, C#, C++, and Scala exist [45].

Since Neo4j is a native graph database, it fully realizes a true graph model, even at the storage level. The information is kept just as it appears on a whiteboard, not as a "graph abstraction" over another platform. This is significant because it explains why Neo4j performs better than other graphs and maintains its flexibility.

Cypher, is Neo4j's graph query language, it enables you to retrieve data from the graph, It is similar to SQL for graphs and was inspired by SQL, allowing you to concentrate on the data you want from the graph rather than the steps necessary to obtain it. [46].

4.6 Ontology Language

OWL (Web Ontology Language): It is a knowledge representation language that contributed to the building, dissemination, and development of the ontology, developed by the W3C (World Wide Web Consortium) in 2004, it is designed to be read by computer applications. XML is used to write OWL, it is simple to exchange OWL information between various computer kinds utilizing various operating systems and application languages [47].

OWL has three main levels, which are as follows: [48]

- **OWL Lite:** helps users that primarily require a categorization hierarchy and straightforward constraint features. For instance, OWL Lite only allows cardinality values of 0 or 1, even though it enables cardinality constraints. Thesauri and other

taxonomies should be able to migrate to OWL Lite quickly, and providing tool support for it should be easier than for its more expressive cousins.

- **OWL DL:** enables users who need the greatest degree of expressiveness without sacrificing the computational completeness (all entailments are certain to be computed) and decidability (all computations will complete in finite time) of reasoning systems. With limitations like type separation, OWL DL provides all OWL language constructs (a class cannot also be an individual or property, and a property cannot also be an individual or class). The reason for OWL DL's name is that it shares a decidable fragment of first-order logic with the field of study known as description logics [Description Logics]. OWL DL provides favorable computational characteristics for reasoning systems and was created to serve the already-existing Description Logic business area.
- **OWL Full:** is designed for users who desire the highest level of expressiveness, the syntactic flexibility of RDF, and no computational guarantees. For instance, a class in OWL Full can be treated both as a group of individuals and as a standalone individual. The fact that an owl: Data type Property can be designated as an owl: Inverse Functional Property is another important distinction from OWL DL. An ontology can extend the meaning of the pre-defined (RDF or OWL) vocabulary using OWL Full. There is a slim chance that any reasoning program will be able to handle all of OWL Full's features.

Chapter Five

Methodology

This chapter display the outline procedures for creating the ontology that we will employ in our research.

We have developed a dynamic ontology framework with the help of an expert in the field of Islamic sciences, from identifying concepts, relationships, and definitions. Implemented according to the steps listed in section (4.3).

5.1 Dynamic Ontology Development

The ontology development process consists of the following steps:

Step 1: Determine domain of the ontology:

Answering a few questions will help us to determine the ontology domain:

1. What is the domain that the ontology will cover?

The domain is the Bukhari Ahadith specifically the Ahadith of ablution.

2. For what (or how) are we going to use the ontology?

Users include Ahadith experts and any developer who wants to build an extraction system of Ahadith.

3. Who else will use the ontology?

Users who have a passion for research in Ahadith.

4. What questions does the information in the ontology answer?

An Ontology will offer answers to several questions in the field of hadith and narrators.

- What is the First Name and Last Name of the Narrator?
- Who are Narrator Sheikh and Student?
- What is the Tabaqa of the Narrator?
- How many Ahadith narrated by Al-Rawi?
- Is the Narrator Madar?

- The journey in seeking knowledge.
- Is the Hadith Musnad (مسند) Or Moalaq (معلق)?
- Relationship between Narrator Balad and his Sheikh and Students Balad.
- Itisal And Inqitaa.

5. **Source of knowledge:**

Sahih Al-Bukhari.

6. **Scope:**

Which includes the set of terms to be represented, their characteristics, and granularity.

Step 2: **Reuse Existing ontologies.**

We didn't use any previous ontology, so we designed it to suit the required function and built it from scratch.

Step 3: **Enumerate the Important Terms in the Ontology.**

The following questions help us to define terms:

1. **What are the main terms we want to represent?**

The main terms we discuss are Ketab, Bab, Hadith, Narrator, Sink, and Source.

2. **What properties do these terms have?**

- Ketab term has the following properties: KetabID, Ketab Name.
- Bab term has the following properties: BabID, Bab Name.
- Hadith term has the following properties: HadithID, Matan.
- Sink term has the following properties: SinkID, Name.
- Source term has the following properties: SourceID, Name.
- Narrator term has the following properties: First Name, Father Name, Birth Place, Death Place, Birth Date, Death Date, Qunia, Balad, Heard From, Transfer To, Narrated Of, Forebode, Ask, Proposition.

Step 4: Define the Classes and the Class Hierarchy.

And using the terms that we extracted from previous step, we create classes and classify them in a hierarchical taxonomy.

Table 5.1 Describe the classes of ontology and their features.

Table 5.1

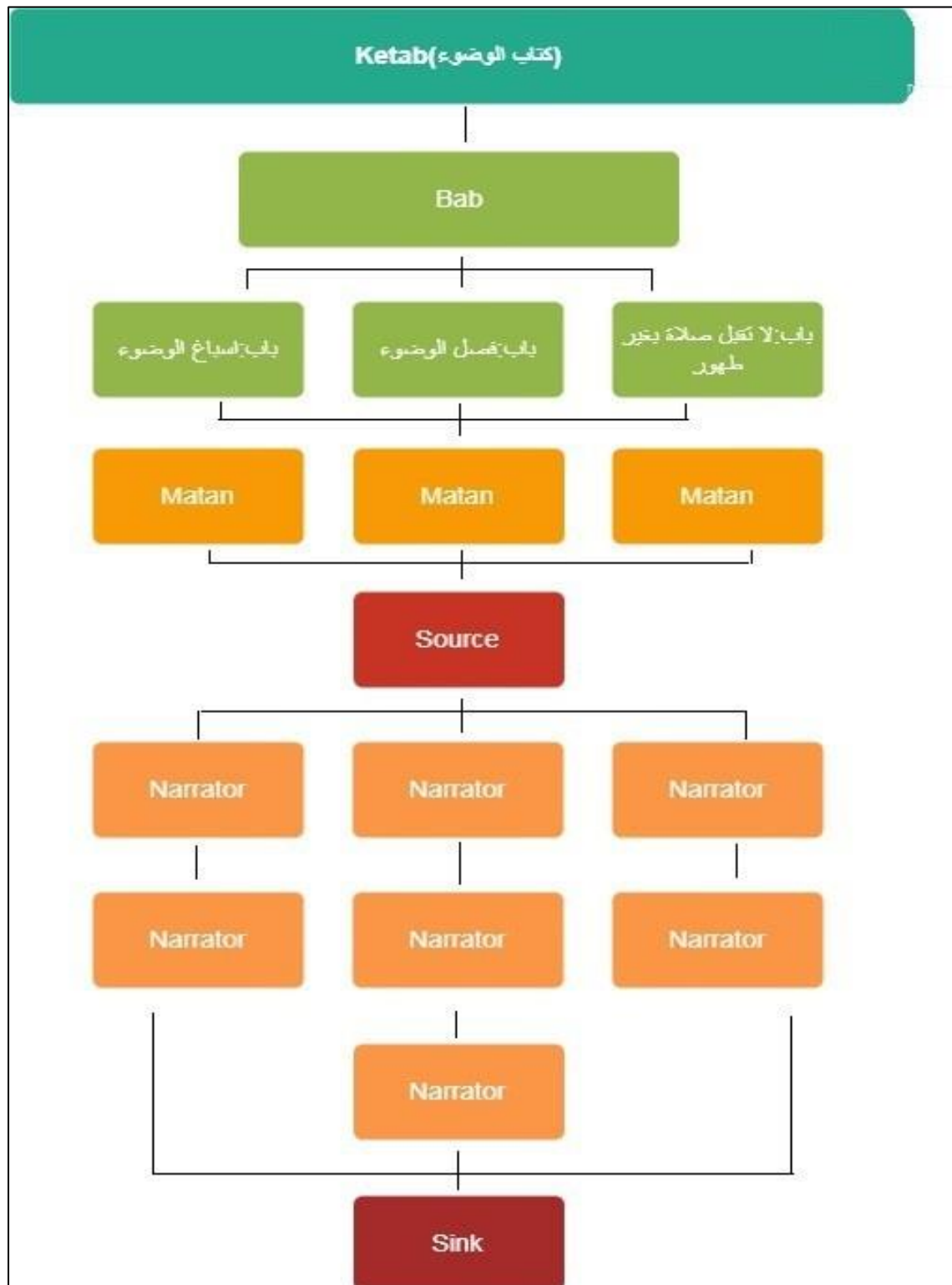
List Of ontology classes and their description

No.	Class	Label	Description
1	Ketab	الكتاب	Represent Ketab of Hadith.
2	Bab	الباب	Represent Bab in Hadith Ketab.
3	Hadith	الحديث	Represent Hadith Sanad and Matan.
4	Sink	عالم الحديث	The sink node of all paths (Albukhari).
5	Source	مصدر الحديث	The source node all paths (Prophet Mohammad (PBUH)).
6	Narrator	الراوي	Represent a person who narrates Hadith.

The taxonomic hierarchy of the ontology is depicted in the figure 5.1. We categorize the major terms into classes and their sections into subclasses. For example class bab is a subclass of ketab class.

Figure 5.1

Ontology classes in a hierarchical taxonomy



Step 5: Define the Properties of Classes (Slots).

After defining the classes, we clarify the internal structure of the concepts, and there are two types of Properties:

- Object Property: use to link objects to objects.
- Data Property: use to link object to data type.

Table 5.2

Ontology object property and their description

No.	Object property	Domain	Range	Description
1	SinkOf	Sink	Ketab	Ketab that the sink is an author.
2	hasSink	Sink	Ketab	Person Who Author the Ketab.
3	BabOf	Ketab	Bab	Bab that Ketab Contain.
4	hasBab	Ketab	Bab	Bab that this Ketab include.
5	ContainOf	Ketab	Hadith	Hadith that contained in Ketab.
6	hasContain	Ketab	Hadith	Ketab which contain this Hadith.
7	Hadith-of	Bab	Hadith	Bab that includes this Hadith
8	has-Hadith	Bab	Hadith	Hadith that this Bab contain.
9	Heard-From	Narrator	Narrator	Narrator who hear hadith, whether from another narrator or from the source.
10	TransferTo	Narrator	Narrator	Narrator who told hadith, whether from the source or a different narrator.
11	NarratedOf	Narrator	Narrator	Narrator who narrated hadith either from another narrator or the source.
12	Forebode	Narrator	Narrator	Narrator who forebode the hadith through another narrator or the source.
13	Ask	Narrator	Narrator	Narrator who ask the hadith, whether from another narrator or from the source.
14	Proposition	Narrator	Narrator	Narrator who say hadith.
15	NarratorOf	Hadith	Narrator	Hadith narrated by the narrator.
16	hasNarrator	Hadith	Narrator	Narrator whoever narrated hadith.
17	Say	Hadith	Narrator	Narrator who's say hadith.
18	write	Hadith	Narrator	Narrator who write hadith.
19	Read on Sheikh	Hadith	Narrator	Narrator who Read on Sheikh Hadith.
20	Thakar Fulan	Hadith	Narrator	Hadith thaker by narrator.
21	Rawa	Hadith	Narrator	Hadith has rawa by narrator.
22	Father for	Narrator	Narrator	The narrator is narrator's father.
23	hasFather	Narrator	Narrator	Narrator has Father Narrator.
24	Uncle-of	Narrator	Narrator	Narrator is narrator's uncle.
25	has-uncle	Narrator	Narrator	Narrator has an uncle narrator.

Table 5.3*Ontology data properties and their description*

No.	Data Property	Domain	Range	Description
1	Id	Narrator,Hadith	Integer	The identifier for Narrator,Hadith and Bab.
2	First Name	Narrator	String	The First name for the Narrator.
3	Father Name	Narrator	String	The Father name for the Narrator.
4	Birth Date	Narrator	Date	The Narrator's date of birth.
5	Death Date	Narrator	Date	The Narrator's date of death.
6	Birth Place	Narrator	String	The Narrator's place of birth.
7	Death Place	Narrator	String	The Narrator's place of death.
8	Qunia	Narrator	String	The Narrator's qunia.
9	Balad	Narrator	String	The Narrator's balad.
10	Hadith Text	Hadith	String	The Hadith text (Matan).
11	Bab Name	Bab	String	The Name of the Bab.
12	Ikhbar Tool	Narrator	String	The connection tool between Narrator.
13	Ketab Name	Ketab	String	The Name of the Ketab.
14	Source Name	Source	String	The Name of the Source.
15	Sink Name	Sink	String	The Name of the Sink.

Step 6: Define the Facets (role restrictions) of the slots.

Here, we set restrictions on the slot by defining the facets, including the data type, acceptable values, the cardinality of the property, and another attribute.

Step 7: Create Instances.

We can summarize this step by add instances of classes to the ontology, defining each instance's name, description, any concept it belongs to, and value.

5.2 Dynamic Ontology Prototype

This part, we will provide a description of the system in details, including each component's design, implementation, and role it plays in achieving the goal of the system. The core of Dynamic Ontology Prototype It is an ontology that is created dynamically in the Ahadith of the Prophet and the sanad processing in the field of Islamic law, specifically in the field of ablution.

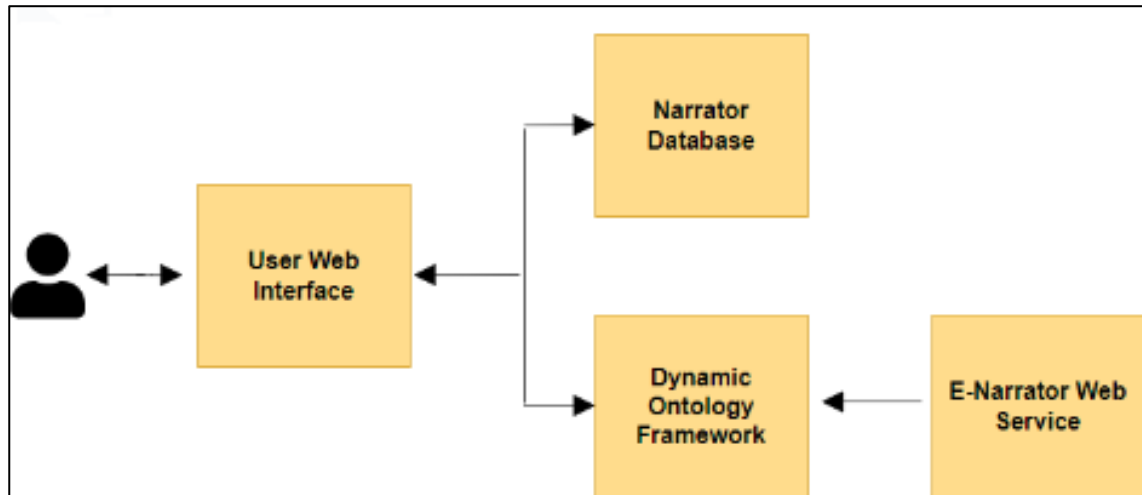
5.2.1 System Design**5.2.1.1 System Architecture**

In this section, we describe the system architecture of the dynamic ontology framework for Bukhari Ahadith.

The architecture of the Dynamic Ontology Framework is shown in Figure 5.2 presents the components and the interactions between them.

Figure 5.2

System Architecture



The system begins with the user entering the required data about the narrators and Ahadith through the user web interface, then directly forwarded to the narrator database to store data, and connecting with the ontology to create nodes and relationships.

5.2.1.2 Tools and Programs

The following programs and tools were used to construct the system:

- Neo4j to create the ontology.
- Python, Html, and Mysql for implementing the system.

5.2.1.3 Component of the Prototype

- User Web Interface.

The function of this interface is to allow the user to enter the following information into the system: Narrators' information (First Name, Last Name, Birth Place, Death Place, Birth Date, Death Date, Qunia, Balad), hadith number, Bab name and number, and hadith text (Matan).

Figure 5.3

User web interface Arabic

The interface is divided into two main sections: 'بيانات الراوي' (Narrator Data) and 'بيانات الحديث' (Hadith Data). The 'Narrator Data' section contains a grid of input fields for: الاسم (Name), اسم الأب (Father's Name), مكان الولادة (Birth Place), مكان الوفاة (Death Place), تاريخ الولادة (Birth Date), تاريخ الوفاة (Death Date), الكنية (Kunya), and أداة الإخبار (Ikhbar Tool). The 'Hadith Data' section contains a large text area for 'المَتْن' (Matan) and three input fields for: رقم الحديث (Hadith ID), رقم الباب (Bab Number), and اسم الباب (Bab Name). An 'إضافة' (Add) button is located at the bottom center.

Figure 5.4

User web interface English

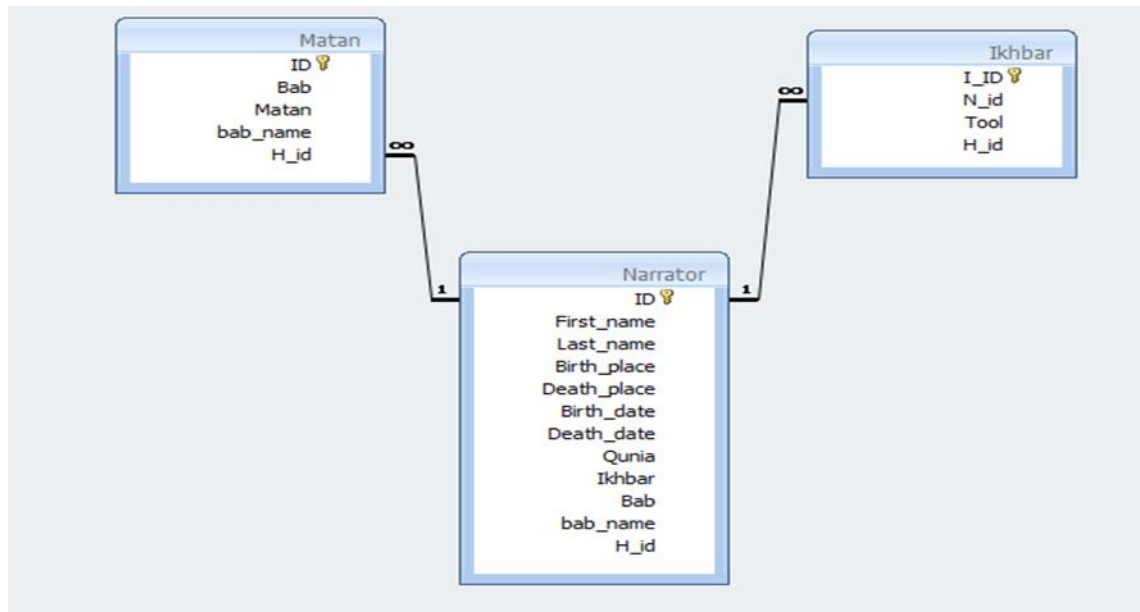
The interface is divided into two main sections: 'Narrator Data' and 'Hadith Data'. The 'Narrator Data' section contains a grid of input fields for: First Name, Father Name, Birth Place, Death Place, Birth Date, Death Date, Qunia, and Ikhbar Tool. The 'Hadith Data' section contains a large text area for 'Matan' and three input fields for: Hadith ID, Bab Number, and Bab Name. An 'ADD' button is located at the bottom center.

- Narrator Database.

The database is used to store the narrators. The database contains three tables: Narrators, Matan and. The relationships between the tables are shown by figure 5.5.

Figure 5.5

Narrator Database



- Narrator Web Service.

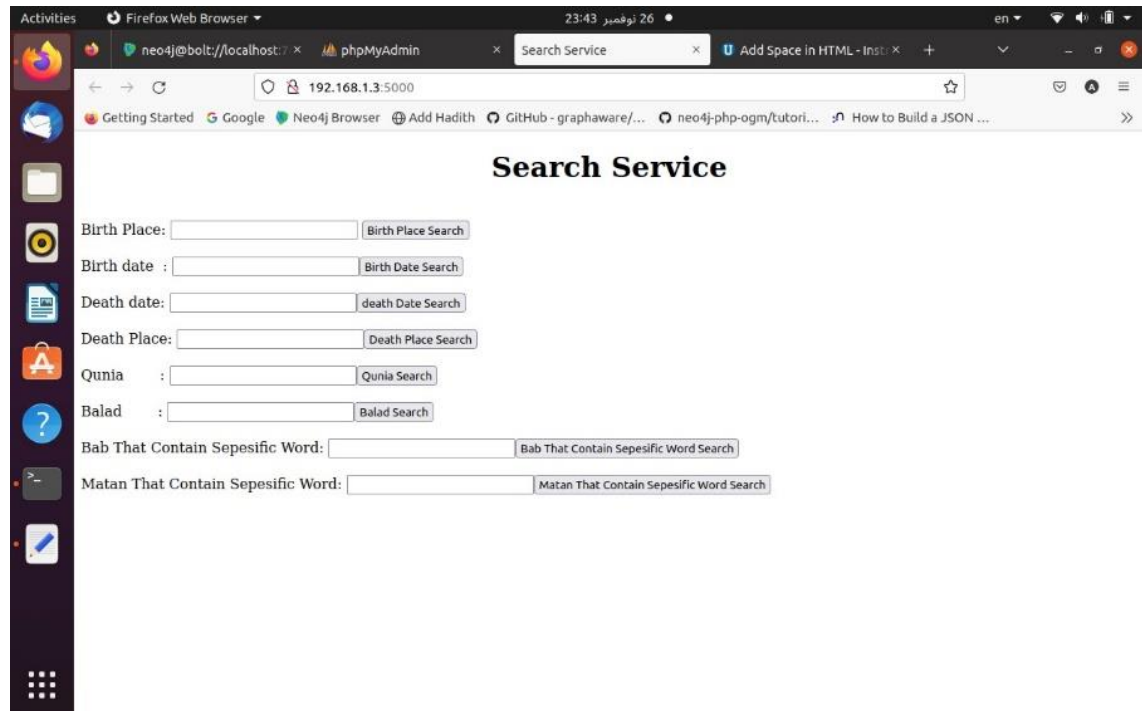
It answers several questions, including the number of Ahadith that he narrated, the importance of the narrator, his journey in seeking knowledge, and is it a centerpiece (Madar) of the isnad tree.

- Searching Service.

This service provides an ontology search for the narrator's data or for words in the matan of the hadith. Figure 5.6.

Figure 5.6

Searching service interface



- Dynamic Ontology Framework.

It contains all the hadith information (sanad and matan) and the relationships between them.

- Dynamic Ontology monitoring and modification.

The ontology that is being built should be monitored by comparison with manual work in building the isnad tree. Modifying the ontology includes adding a hadith, deleting a hadith, and displaying ontology in whole or in parts.

The process of deleting a hadith includes selecting the hadith to be deleted, then deleting the relationships between the narrators node and the other nodes (first name, father's name, Birth Place, Birth Date, Death Place, Death Date, Qunia, Balad) and deleting the relationship between the Ketab, Bab, and Matan, then deleting Ketab node, Bab node and Matan node. Figure 5.7 –See Appendix C– shows the process of deleting hadith number 167 from the ontology.

5.2.1.4 System Diagrams

- **Deployment Diagram**

It gives a visualization of the system and includes the nodes (hardware and software) and the relationships between them (middleware) and enables us to understand how the system is deployed on the hardware. See Figure 5.8 –Appendix C–

Sequence Diagram

It describes how the objects and components interact with each other to complete the required process and the order in which these reactions occur, and is represented by a timeline that starts from the top and goes down gradually to distinguish the sequence of reactions. See Figure 5.9 –Appendix C–

5.2.2 System Implementation

- **User Web Interface**

We have implemented this interface by using HTML, Python Flask, and Mysql Database. Python Flask connected to database which contain narrators and Ahadith data. It allows users to add all hadith required data. Figures 5.10 –See Appendix C–.

5.11 –See Appendix C– shows an example of the add hadith interface.

The design of the user web interface demonstrates that it contains two parts: the first part is narrator data, and the second part is hadith data.

- **Narrator Database**

The database was created by Mysql Tool and it was implemented using python language. We insert data from the ablution ketab since we choose it as a sample from the Bukhari book of our system. The data contain the narrator, matan, and.

- **Narrator Web Service**

This service has been implemented using python and neo4j environment via cypher query. Figure 5.12 –See Appendix C– presents the narrator Aisha, may God be pleased with her example as input in Narrator Web Service.

- **Searching Service**

The task of this part is to search for the entered words according to the following steps:

- Enter the search words (whether words or dates).
- Matching the words with the terms and returning the results, and there are two types of search:
 1. Search for the narrator's information (qunia, date and place of birth, date and place of death, balad) the result will be the narrator's name and number. –See Figure 5.13 Appendix C–
 2. Search for a word in the matan or the bab name, and the result as shown in figure 5.14 and figure 5.15 –See Appendix C–.

- **Ahadith Al-Moalaq**

To search for Ahadith Al-Moalaq within the ontology, total number, hadith id and execution time –See Figure 5.16 Appendix C–.

- **Ruwah Balad**

Bring the balad information for the narrators of the hadith that was entered, to be used in judging the hearing of the narrators, their adherence, and for other matters related to the sciences of hadith –See Figure 5.17 Appendix C–.

- **Dynamic Ontology Framework**

To build an ontological framework $F = (N, E)$ where the set N is the set of all nodes in the ontology and they represent all possible data related to Ahadith like Rawi, Hadith, Place, Date, ...etc. and E is the set of relations possible relations between nodes like He told us, we heard, from, I saw, etc –See Figure 5.18 Appendix C–.

Chapter Six

Adding Hadith (Ontology Expansion)

In this chapter, we will explain how the dynamic ontology framework prototype work. By present the mechanism of adding hadith as follow:

6.1 Add Hadith

1. Choose Hadith:

We choose hadith no. 159, bab (الوضوء ثلاثا ثلاثا), bab no. 24.

2. **Enter Narrators and Hadith information through User Web Interface:** Which includes the information of narrators as previously identified, bab name, bab no and matan as shown in figure 6.1 –See Appendix C–.

3. **Submit Adding Hadith:** –See Figure 6.2 Appendix C–

4. Enter hadith to database:

Connect to mysql database then insert all form element in tables –See Figure 6.3 Appendix C–.

5. Add Hadith to ontology: including this steps:

- Connect to Neo4j platform –See Figure 6.4 Appendix C–.
- Create Ketab, Bab, Matan Nodes if not existing.

Ketab: الوضوء

Bab: الوضوء ثلاثا ثلاثا

Matan: “ دعا بإناء فأفرغ على كفيه ثلاث مرار فغسلهما ثم أدخل يمينه في الإناء فمضمض واستنشق ثم غسل وجهه ثلاثا وبديه إلى المرفقين ثلاث مرار ثم مسح برأسه ثم غسل رجله ثلاث مرار إلى الكعبين ثم قال: قال رسول الله صَلَّى الله عليه وسلم: من توضأ نحو وضوئي هذا ثم صلى ركعتين لا يحدث فيهما نفسه غفر له ما تقدم من ذنبه” –See Figure 6.5 Appendix C–

- Create Source, Sink Nodes (once when the system is executed in the first time) –See Figure 6.6, 6.7 Appendix C–.
- Create Narrator node if not existing.

In this hadith we have six narrator, and figure 6.8 –See Appendix C– show the narrator

((محمد بن مسلم (ابن شهاب)) node.

- Create Narrator property node (first name, father name, birth place, birth date, death place, death date, qunia, balad) once when the system is executed in the first time –See Figure 6.9 Appendix C–.
- Create Relation between Narrator node and Narrator property node –See Figure 6.10 Appendix C–.
- Create Relation between entered Narrator and next and previous Narrator node as entered in interface form –See Figure 6.11 Appendix C–.
- Create Relation between first entered Narrator in form and Sink node –See Figure 6.12 Appendix C–.
- Create Relation between last entered Narrator in form and Source node –See Figure 6.13 Appendix C–.
- Create Relation between Bab node And Ketab node –See Figure 6.14 Appendix C– .
- Create Relation between Bab node And Matan node –See Figure 6.15 Appendix C–.
- Create Relation between Matan node And Source node –See Figure 6.16 Appendix C–
- Visualize hadith isnad tree.

Figure 6.17 –See Appendix C–show all hadith nodes and relations between them.

- Visualize the ontology –See Figure 6.18 Appendix C–.

6.2 Delete Hadith

As for the mechanism for deleting hadith from the dynamic ontology framework, it is as follow:

1. Choose Hadith:

We choose hadith no. 167, bab (التيمن في الوضوء و الغسل) , bab no. 31 –See Figure 6.19 Appendix C–.

2. Enter Hadith no. through Delete Web Interface –See Figure 6.20 Appendix C–:

3. Delete Relation between Narrators node which was connected in relations hadith ID 167, also include Sink and Source nodes.
4. Delete Relations between kitab, Bab and Matan nodes.
5. Delete Bab, Matan node.
6. Ensure that the hadith is deleted.

Figure 6.21 –See Figure 6.21, 6.22 Appendix C– show that hadith does not exist anymore.

Chapter Seven

Experiments and Results

In this chapter, we will present the experimental design and results, through experiments conducted on the system, which are used to evaluate the effectiveness of the system in building a dynamic ontological framework for Bukhari Ahadith.

7.1 Experimental setting

The data set that was used in evaluating the system is the ablution book from Sahih Al-Bukhari, and it contains (75) various chapters, containing (114) noble prophetic Ahadith. Four Ahadith contained transformation (a special case in drawing the chain of isnad), which are the Ahadith whose numbers are (137 - 214 - 230 - 240).

After we imagined and design the ontology framework, the initial step was drawing isnad trees, which begin with assigning the names and information of the narrators to them. Since that the main users of the project are specialists in Sharia sciences, we assumed that they traced the methods of identifying the known narrators (from works, investigative books, graduation books).

The user will enter all the required data (narrators and hadith data) through a user web interface, and the system automatically will add the hadith to the existing framework and link it with the correct place according to the sequence (book – bab - matan - chain of narrators). By creating nodes (narrator, matan, bab, source, sink) that do not exist and linking them through relationships that have several characteristics, including the hadith number and the formula.

7.2 Queries

It is a set of questions created in collaboration with specialists in the field of Sharia sciences and Prophetic Ahadith to examine the system and evaluate the mechanism of drawing isnad trees. Queries were specifically about the narrators. Table 7.1 displays the queries generated to check and evaluate the ontology.

Table 7.1*User query*

No.	Query
1	Is there a relationship between the sink and the narrator?
2	Is there a relationship between the source and the narrator?
3	Is there a relationship between the narrator and the other narrator?
3.1	Rawi Student.
3.2	Rawi Sheikh.
4	Is the narrator Madar?
4.1	Main Madar.
4.2	Sub Madar.
5	Itisal And Inqitaa.
6	The journey in seeking knowledge.
7	The Ahadith ID narrated by the narrator.
8	The total number of Ahadith narrated by the narrator according to the entry in the ontology.
9	Rawi Tabaqa.
10	Is the hadith Musnad Or Moalaq?
11	Relationship between Narrator Balad And his Sheikh and Students Balad.

And as a clarification of some questions, we can define the madar as the node from which more than one relationship comes out, it is divided into two parts: the main madar and a sub madar, and it is determined by its direct relationship with the source node [23]. While the narrator tabaqa is the time intervals of hadith narrators according to death date, and the scholars of the Prophet's hadith divided it into twelve layers as follows [24]:

- Sahabee صحابي: Tabaqa (1).
- Tabee تابعي Tabaqa (2-6.)
- Tabe Tabee التابع التابع: Tabaqa (7-8).
- Akhed An Tabe Tabee اخذ عن تبع الاتباع: Tabaqa (9-12).

And we have adopted the narrator tabaqa according to the four previously mentioned layers.

The journey in seeking knowledge can be described as travel, movement, and pursuit in searching for knowledge [25]

In Figure 7.1 –See Appendix C–, we run a query for Abu Huraira Narrator, and the results that appeared include the Ahadith entered into the ontology.

7.3 System Testing

Here, in this part we demonstrate a system test to evaluate its effectiveness in creating the dynamic ontology framework and add Ahadith to it, and whether it behaves as expected or not, as well as drawing isand tree, accuracy, completeness, conciseness, adaptability, clarity, computational efficiency, consistency and compare searches in the ontology with searches in Sahih Al-Bukhari, either manually or through available applications such as the Alshamela library.

7.4 Evaluation

This section presents the ontology evaluation mechanism as explained in section 4.4 (Ontology Evaluation).

To achieve this, we have explained and clarified the following criteria:

- Accuracy: How close the test results (query) are to the real results [49]. To make sure of this, we compared the results of the queries resulting from the ontology with manual results conducted by a number of people, including the answers to the questions that were mentioned in table 7.1. The narrator (Abu Huraira) was chosen and the query was carried out through the ontology and compared with the results of 10 people, and the results for the ontology query were as follows in table 7.2. And the results of the people in the search were as shown in table 7.3, 7.4

Table 7.2

Ontology query result

Query No.	Ontology Query Result
1	No
2	Yes
3	3.1 Rawi Student: عبد الرحمن هرمز، عائذ الله عبد الله، ذكوان السمان، سعيد ابي السعيد، عبيد الله عبد الله، نعيم عبد الله، محمد زياد 3.2 Rawi Sheikh: الرسول صلى الله عليه وسلم
4	4.1 Main Madar: Yes. 4.2 Sub Madar: No.
5	اتصال
6	تنقل طلبا للعلم
7	135-136-155-161-162-165-172-173-176-220-237-238-239
8	13 Hadith
9	صحابي
10	مسند
11	ادم - شعية - ليس نفس البلد شعية - محمد - نفس البلد محمد - عبد الرحمن - ليس نفس البلد

Table 7.3

Manual query result

Sample Query	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Query 1	لا	لا	لا	لا	لا
Query 2	نعم	نعم	نعم	نعم	نعم
Query 3.1	عائذ الله بن عبد الله، همام بن منبه، عبد الرحمن بن هرمز، عبيد الله بن عبد الله، سعيد بن أبي السعيد، ذكوان السمان، محمد بن زياد، نعيم بن عبد الله	همام بن منبه، نعيم المجر، سعيد بن عمرو، أبو إدريس، الأعرج، محمد بن زياد، أبي صالح، سعيد المقبري، عبيد الله بن عبد الله	همام بن منبه، نعيم المجر، سعيد بن عمرو، أبو إدريس، الأعرج، محمد بن زياد، أبي صالح، سعيد المقبري، عبيد الله بن عبد الله	همام بن منبه، نعيم المجر، سعيد بن عمرو، أبو إدريس، الأعرج، محمد بن زياد، أبي صالح، سعيد المقبري، عبيد الله بن عبد الله	همام بن منبه، نعيم المجر، سعيد بن عمرو، أبو إدريس، الأعرج، محمد بن زياد، أبي صالح، سعيد المقبري، عبيد الله بن عبد الله
Query 3.2	الرسول صلى الله عليه وسلم	الرسول صلى الله عليه وسلم	الرسول صلى الله عليه وسلم	الرسول صلى الله عليه وسلم	الرسول صلى الله عليه وسلم
Query 4.1	مدار رئيسي	مدار رئيسي	مدار رئيسي	مدار رئيسي	مدار رئيسي
Query 4.2	ليس مدار فرعي	ليس مدار فرعي	ليس مدار فرعي	ليس مدار فرعي	ليس مدار فرعي
Query 5	اتصال	اتصال	اتصال	اتصال	اتصال
Query 6	تنقل	تنقل	تنقل	تنقل	تنقل
Query 7	161-239-238-237-220-176-173-162-155-172-165-135-136	135-136-155-161-162-165-172-173-176-220-237-238	135-136-155-161-162-165-172-173-176-220-237-238-239	135-136-155-161-162-165-172-173-176-220-237-238	135-136-155-161-162-165-172-173-176-220-237-238-239
Query 8	13	١٢	13	12	13
Query 9	صحابي	صحابي	صحابي	صحابي	صحابي
Query 10	مسند	مسند	مسند	مسند	مسند
Query 11	شعبة	شعبة	شعبة	شعبة	شعبة
	ادم	ادم	ادم	ادم	ادم
	ليس نفس البلد	ليس نفس البلد	ليس نفس البلد	ليس نفس البلد	ليس نفس البلد
Query 11	شعبة	شعبة	شعبة	شعبة	شعبة
	ادم	ادم	ادم	ادم	ادم
	ليس نفس البلد	ليس نفس البلد	ليس نفس البلد	ليس نفس البلد	ليس نفس البلد
Time/minute	5٥	40	33	٤٩	٤٥

Table 7.4

Manual query result complement

Sample Query	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
Query 1	لا	لا	لا	لا	لا
Query 2	نعم	نعم	نعم	نعم	نعم
Query 3.1	همام بن منبه، نعيم المجرم، سعيد بن عمرو، ابو ادريس، الاعرج، محمد بن زياد، ابي صالح، سعيد المقبري، عبيد الله بن عبد الله	همام بن منبه، نعيم المجرم، سعيد بن عمرو، عائذ الله بن عبد الله، عبد الرحمن بن هرمز، محمد بن زياد، ذكوان، سعيد المقبري، عبيد الله بن عبد الله	همام بن منبه، نعيم المجرم، سعيد بن عمرو، عائذ الله بن عبد الله، الاعرج، محمد بن زياد، ابي صالح، سعيد المقبري، عبيد الله بن عبد الله	همام بن منبه، نعيم المجرم، سعيد بن عمرو، ابو ادريس، الاعرج، محمد بن زياد، ابي صالح، سعيد المقبري، عبيد الله بن عبد الله	همام بن منبه، نعيم المجرم، سعيد بن عمرو، عائذ الله بن عبد الله، عبد الرحمن بن هرمز، محمد بن زياد، ذكوان، سعيد المقبري، عبيد الله بن عبد الله
Query 3.2	الرسول صلى الله عليه وسلم	الرسول صلى الله عليه وسلم	الرسول صلى الله عليه وسلم	الرسول صلى الله عليه وسلم	الرسول صلى الله عليه وسلم
Query 4.1	مدار رئيسي	مدار رئيسي	مدار رئيسي	مدار رئيسي	مدار رئيسي
Query 4.2	ليس مدار فرعي	ليس مدار فرعي	ليس مدار فرعي	ليس مدار فرعي	ليس مدار فرعي
Query 5	اتصال	اتصال	اتصال	اتصال	اتصال
Query 6	لم يتنقل	تنقل	تنقل	لم يتنقل	تنقل
Query 7	161-239-238-237-220-176-173-162-155-172-165-135-136	135 -136-155-161-162-165-172-173-176-220-237-238	135 -136-155-161-162-165-172-173-176-220-237-238-239	135 -136-155-161-162-165-172-173-176-220-237-238-239	135 -136-155-161-162-165-172-173-176-220-237-238-239
Query 8	13	١٢	13	13	13
Query 9	صحابي	صحابي	صحابي	صحابي	صحابي
Query 10	مسند	مسند	مسند	مسند	مسند
Query 11	شعبة	شعبة	شعبة	شعبة	شعبة
	ادم	ادم	ادم	ادم	ادم
	ليس نفس البلد	ليس نفس البلد	ليس نفس البلد	نفس البلد ليس	شعبة
	شعبة	شعبة	شعبة	شعبة	شعبة
	محمّد	محمّد	محمّد	محمّد	محمّد
	عبد الرحمن	ابو هريرة	عبد الرحمن	ابو هريرة	محمّد
Time/minute	٣٠	٤٦	٥١	٣٦	٥٣

And the result from the system shows in figure 7.2, 7.3 –See Appendix C–

- **Completeness:** The domain has been completely covered and it is the ablution kitab.
- **Conciseness:** We determine the all (bab) that the ontology covered to ensure that they do not contain irrelevant elements (bab not in the ablution kitab).
- **Consistency:** Describes that the ontology does not contain or allow any contradictions.

By creating nodes based on which to any class it belongs to, then link them together with relations according to what was entered by the user.

As for the deletion process from the ontology, it was confirmed that the hadith is completely deleted including the matan, links between the nodes, the bab and the narrators are not deleted due to the existence of relationships with other Ahadith, and if they are deleted, it causes a defect in the ontology.

- **Adaptability:** The extent to which the ontology response is expected by implementing add, delete and search process, as it was shown previously.
- **Clarity:** By designing it in a way that facilitates the process of tracing the bab and what they contain prophetic Ahadith, including matan and its chain of the narrator (isnad tree).
- **Scalability:** Since the ontology in this research is not large and specialized in one book of Sahih Al-Bukhari which is the book of ablution, it is easy to scalability the ontology by adding nodes for other books and create relationships between them with the same mechanism used in implementing the book of ablution, without producing significant changes in the integrated system's ontological constituents.
- **Computational efficiency:** By measuring the time for adding the hadith to ontology and the execution time for the queries.

Table 7.5

Run time for adding hadith

Hadith No.	Ahadith in Ontology	Hadith Narrator	Narrator in Ontology	Time
135	0	5	0	1.59
172	11	5	3	1.19
139	12	5	2	1.29
161	20	6	2	2.3
236	30	7	6	2.7
182	39	7	0	4.29
194	45	4	4	2 3.1
159	56	6	3	4.09
167	57	5	0	2.43
148	58	6	1	4.10

Table 7.5 present Hadith Number, Total Ahadith in ontology, Total No. of Narrator in hadith, The No. of narrator nodes already in the ontology, and Time complexity in seconds.

Time complexity: “The amount of time taken by an algorithm to execute each statement of code of an algorithm till its completion with respect to the function of the length of the input”.

We can observe that the time changes depending on the total number of Ahadith in ontology and number of previously created narrator nodes in the ontology.

- Compare searches in the ontology with searches in Sahih Al-Bukhari’s book and in database:

By comparing time for searching process in the ontology with the manual search in the ablution ketab, search in database, and search in Alshamela library, for words in bab name, or hadith matan.

Table 7.6

Run time for search in ontology vs. database

Id	Search Statement	Ontology	Database
1	Word: “الوضوء” in Matan	0.00002	0.0011
2	Word: “الوضوء” in Bab	0.0011	0.00079
3	Word: “المغرب” in Bab	0.00076	0.0020
4	Word : “رسول” in Matan	0.0020	0.0010
5	Word : “رجل” in Matan	0.00061	0.0011

Table 7.6 present the execution time in seconds for searches in ontology and databases to specific words, It appears that the average time for searches in ontology equal to 0.000989 seconds, while average searching time in databases equal 0.001198 seconds.

More details about execution time for searching in ontology and in database, you can see Appendix B.

Figure 7.13 –See Appendix C– shows the execution time for search manually in the ablution book, while Figure 7.14 –See Appendix C– shows the execution time for search in the Alshamela library.

During my search for ways to represent the Ahadith of the Prophet, I found some research papers related to this and master's theses as mentioned in the second chapter, we can summarize as follows:

Table 7.7 –see Appendix D- provide a comparison between the different ontologies representing hadiths and the method using in this research.

7.5 Discussion

The system was evaluated to determine its effectiveness and suitability for the job for which it was designed, through the results of inquiries and drawing isnad trees, the isnad trees result were compared with the ones that were drawn manually.

To assess the accuracy of our system, we compared the results of manual queries with the results of system queries, and they were as follows:

- In the manual queries, query No. 3 there was a difference in the names of the narrators, such as (Al-Araj is the same as Abd al-Rahman ibn Hormuz, Abu Idris A'adhullah ibn Abdullah), query No. 8: The number of hadiths was either 12 or 13, and in query No. 11 The difference in the narrators' countries according to the reference on which the person relied in searching for the narrator's information led to different results.
- In the system queries, it depends on the number of Ahadith narrated by a particular Rawi, whether they were fully entered into the framework or not. If they were all entered, the results will be identical, but if not all of them are entered, the results will depend on what is in the framework.
- The chosen narrator (Abu Huraira), and all his Ahadith were previously entered into the framework, In query 3, the student names were according to the narrator's first name and his father's name, according to what the framework was designed, and in query No. 11, we relied on obtaining the narrator's information from the application of the Nine Books Collector of the Arab House for Information Technology.

As for the time, it took the researcher to answer the queries and obtain the results manually, an average of 43.8 minutes, while the time the system took not more than 10 seconds to draw the trees after entering all the required data (which was available to the user) and 5 seconds to get results. Queries and 3 seconds to search within the ontology for any word or data related to the narrators.

Here we must mention some of the challenges we faced in the work:

- The lack of sufficient information about the narrator's tarjamet (narrators information), as some narrators do not have any data for the birth place or birth date, death place or death date, and the balad. In order to avoid any problem due to its unavailability, we have set "no" for the place of birth, death, or balad, and "zero" for the date of birth or death.
- The Arabic language and the treatment of its letters, such as ا and إ, as the programming language considers them two different letters. For example, if the narrator's nickname أبو هريرة or أبو هريرة is entered, he will create two different nodes that are originally one node and will lead to a malfunction. In order to avoid this, we adopted the alif without a hamza "ا" in the entry, as well as the case with the letter ت "ت" and haa ه, we adopted the haa "ه".
- Some Bab in the ablution ketab is without a name or number, such as the next bab to bab 40, and the next to bab 56. In addition, bab has a name and no number, such as the next to bab 58.

Chapter Eight

Conclusion and Future Work

At a time when information has become closer to us than pressing a button on the keyboard, and since there is an interest in representing knowledge of the books of Ahadith that led to development several classifications and algorithms to extract knowledge, the need to develop Islamic content still requires improvement and development better.

Due to interdependent relationship between Holy Qur'an and noble Prophetic Ahadith, Ahadith came to explain some of the provisions contained in the Holy Qur'an or to inform about legislation that was not mentioned in it.

Ontology facilitated the process of extracting knowledge from Arabic historical texts and transforming them from unstructured texts into structured ones.

This research's primary contribution is to automated build an ontology framework for the prophetic Ahadith that makes information retrieval from the ontology easy and fruitful with high accuracy and significantly more user satisfaction than traditional methods.

This research was distinguished from other researches the process of building ontology was automated while others were manual, the execution time of the different ontology operations (add, search, delete) was better than the traditional manual methods and databases. Also, we were able to draw and visualize the narrators nodes and their relationships, which makes it easier for specialists and those interested in the sciences of hadith to identify new meanings through the connections between the narrators to open new horizons for research and shorten time.

8.1 Recommendation and Future Work

Since just one book from Sahih Al-Bukhari was chosen, and the research was based on it, there are numerous ways to make improvements and go forward. There are a few of them:

- Expanding the ontology to include other nodes (Laqab, rank, reason for hadith, Explanation of the hadith) to help judge narrators, and judge Ahadith more accurately.
- Classifying Ahadith according to topics and facilitate the process of extracting the relationships between them.

- Expanding the work to serve the science of takhreej Ahadith by drawing the chain of the narrator (isnad trees) and judging the narrators after collecting Ahadith from the main books, not only Sahih Al-Bukhari.

List of Abbreviations

Abbreviations		Meaning
OWL	Web Ontology Language	
XML	eXtensible Markup Language	
DL	Description Logic	
RDF	Resource Description Framework	

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Appendices

Appendix A

Resource Description Framework (RDF)

In this chapter we will give a brief explanation of the Resource description Framework And show an illustrative example on sub graph.

A framework for describing resources on the Web, developed by the World Wide Web Consortium (W3'C).

The need for it arose after the increase in data collected through various internet sites, as it facilitates the process of data exchange and sharing in light of the use of different models for storing information on the sites.

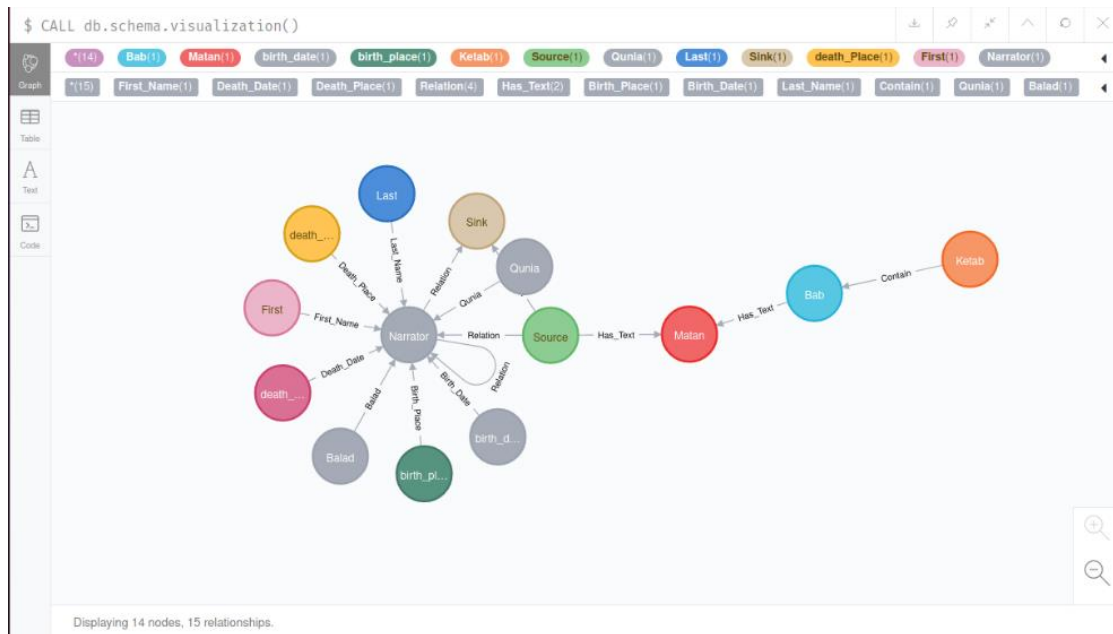


Figure shows ontology schema visualization (nodes and relationships).

RFD Structure:

The information is represented as triple: Subject, Predicate, Object.

RDF Serialization:

We can define it as the process of writing RDF graphs in a machine-readable format. Like RDF/XML, Turtle, N-Triples.

Represent data in RDF:

In our prototype we represent data in RDF/XML and Turtle format as follow:

- **RDF/XML** : Implement main node in ontology(Ketab, Sink, Source, Hadith, Bab, Narrator).

```
<?xml version="1.0"?>
```

```
<rdf:RDF
```

```
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:Dynamic-Ontology-Framework="http://localhost:5000/Dynamic-Ontology-
```

```
Framework#">
```

```
<rdf:Description
```

```
  rdf:about="http://localhost:5000/ Dynamic-Ontology-Framework/Ketab"
```

```
    Dynamic-Ontology-Framework:ID=" " "
```

```
    Dynamic-Ontology-Framework:Name = "Ablution" />
```

```
<rdf:Description
```

```
  rdf:about="http://localhost:5000/ Dynamic-Ontology-Framework/Sink"
```

```
    Dynamic-Ontology-Framework:ID=" " "
```

```
    Dynamic-Ontology-Framework:Name = "AlBukhari" />
```

```
<rdf:Description
```

```
  rdf:about="http://localhost:5000/ Dynamic-Ontology-Framework/Source"
```

```
    Dynamic-Ontology-Framework:ID=" " "
```

```
    Dynamic-Ontology-Framework:Name = "Prophet PBUH" />
```

```
<rdf:Description
```

```
  rdf:about="http://localhost:5000/ Dynamic-Ontology-Framework/Hadith"
```

```
Dynamic-Ontology-Framework:ID=" "
Dynamic-Ontology-Framework:Text = "" />
```

```
<rdf:Description
```

```
  rdf:about=http://localhost:5000/ Dynamic-Ontology-Framework/Bab>
```

```
<Dynamic-Ontology-Framework:ID> </Dynamic-Ontology-Framework:ID>
```

```
< Dynamic-Ontology-Framework:Name>
```

```
<rdf:Seq>
```

```
<rdf:li>Bab1</rdf:li>
```

```
<rdf:li>Bab2</rdf:li>
```

```
<rdf:li>Bab3</rdf:li>
```

```
<rdf:li>Bab4</rdf:li>
```

```
<rdf:li>Bab5</rdf:li>
```

```
</rdf:Seq>
```

```
</ Dynamic-Ontology-Framework:Name>
```

```
</rdf:Description>
```

```
<rdf:Description
```

```
  rdf:about=http://localhost:5000/ Dynamic-Ontology-Framework/Narrator
```

```
    Dynamic-Ontology-Framework:ID = " "
```

```
    Dynamic-Ontology-Framework:First-Name = " "
```

```
    Dynamic-Ontology-Framework:Father-Name = " "
```

```
    Dynamic-Ontology-Framework:Birth-Place = " "
```

```
    Dynamic-Ontology-Framework:Birth-Date = " "
```

```
    Dynamic-Ontology-Framework:Death-Place = " "
```

```
    Dynamic-Ontology-Framework:Death-Date = " "
```

```
    Dynamic-Ontology-Framework:Qunia = " "
```

```
    Dynamic-Ontology-Framework:Balad = " " />
```

```
</rdf:RDF>
```

- **Turtle** : Implement main node in ontology(Ketab, Sink, Source, Hadith, Bab, Narrator).

@prefix neo4voc: <http://neo4j.org/vocab/sw#> .

@prefix neo4ind: <http://neo4j.org/ind#> .

neo4ind:ketab neo4voc:name "Ablution" ;

a neo4voc:Ketab;

neo4voc:ID "" ;

neo4voc:Contain neo4ind:bab1 .

neo4ind:bab1 neo4voc:name "Bab" ;

a neo4voc:Bab;

neo4voc:ID "" .

neo4voc:Has_Text neo4ind:matan

neo4ind:matan neo4voc:name "Matan" ;

a neo4voc:Matan;

neo4voc:ID "" .

neo4ind:source neo4voc:name "Source" ;

a neo4voc:Source;

neo4voc:ID "" .

neo4voc:Has_Text neo4ind:matan

neo4voc:Relation neo4ind:narrator

neo4ind:narrator neo4voc:name "Narrator" ;

a neo4voc:Narrator;

neo4voc:ID "" .

neo4voc:Relation neo4ind:sink

neo4ind:sink neo4voc:name "Sink" ;

a neo4voc:Sink;

neo4voc:ID "" .

neo4ind:first neo4voc:name "First" ;

a neo4voc:First;

neo4voc:ID "" .

neo4voc:First_Name neo4ind:narrator

neo4ind:last neo4voc:name "Last" ;

a neo4voc:Last;

neo4voc:ID "" .
 neo4voc:Last_Name neo4ind:narrator
 neo4ind:balad neo4voc:name "Balad" ;
 a neo4voc:Balad;
 neo4voc:ID "" .
 neo4voc:Balad neo4ind:narrator
 neo4ind: deathdate neo4voc:name "death_Date" ;
 a neo4voc: death_Date;
 neo4voc:ID "" .
 neo4voc: Death_Date neo4ind:narrator
 neo4ind: deathplace neo4voc:name "death_Place" ;
 a neo4voc: death_Place;
 neo4voc:ID "" .
 neo4voc: Death_Place neo4ind:narrator
 neo4ind: birthdate neo4voc:name "birth_date" ;
 a neo4voc:birth_date;
 neo4voc:ID "" .
 neo4voc: Birth_Date neo4ind:narrator
 neo4ind: birthplace neo4voc:name "birth_place" ;
 a neo4voc:birth_place;
 neo4voc:ID "" .
 neo4voc: Birth_Palce neo4ind:narrator
 neo4ind: qunia neo4voc:name "Qunia" ;
 a neo4voc:Qunia;
 neo4voc:ID "" .
 neo4voc: Qunia neo4ind:narrator

Illustrative example: Hereafter is a RDF of the sub-graph of the narrator Asma, may God be pleased with her, for Ahadith id 184 and 227 on bab No. 37, 63 respectively.

@prefix neo4voc: <http://neo4j.org/vocab/sw#> .

@prefix neo4ind: <http://neo4j.org/ind#> .

```
neo4ind:ketaab neo4voc:name "Ablution" ;
    a neo4voc:Ketaab;
    neo4voc:ID "" ;
    neo4voc:Contain neo4ind:bab63 .
    neo4voc:Contain neo4ind:bab37 .

neo4ind:bab1 neo4voc:name "Bab" ;
    a neo4voc:Bab;
    neo4voc:ID "63" .
    neo4voc:Has_Text neo4ind:matan227

neo4ind:bab1 neo4voc:name "Bab" ;
    a neo4voc:Bab;
    neo4voc:ID "37" .
    neo4voc:Has_Text neo4ind:matan184

neo4ind:matan227 neo4voc:name "Matan" ;
    a neo4voc:Matan;
    neo4voc:ID "227" .

neo4ind:matan184 neo4voc:name "Matan" ;
    a neo4voc:Matan;
    neo4voc:ID "184" .

neo4ind:source neo4voc:name "Source" ;
    a neo4voc:Source;
    neo4voc:ID "" .
    neo4voc:Has_Text neo4ind:matan227
    neo4voc:Has_Text neo4ind:matan184
    neo4voc:Relation neo4ind:Asma

neo4ind:Asma neo4voc:name "Asma" ;
    a neo4voc:Narrator;
    neo4voc:ID "" .
    neo4voc:Relation neo4ind:Fatima
```

neo4ind:Fatima neo4voc:name "Fatima" ;
 a neo4voc:Narrator;
 neo4voc:ID "" .
 neo4voc:Relation neo4ind:Hisham
 neo4ind:Hisham neo4voc:name "Hisham" ;
 a neo4voc:Narrator;
 neo4voc:ID "" .
 neo4voc:Relation neo4ind:Yahya
 neo4voc:Relation neo4ind:Ismail
 neo4ind:Yahya neo4voc:name "Yahya" ;
 a neo4voc:Narrator;
 neo4voc:ID "" .
 neo4voc:Relation neo4ind:Mohammad
 neo4ind:Malik neo4voc:name "Malik" ;
 a neo4voc:Narrator;
 neo4voc:ID "" .
 neo4voc:Relation neo4ind:Ismail
 neo4ind:Mohammad neo4voc:name "Mohammad" ;
 a neo4voc:Narrator;
 neo4voc:ID "" .
 neo4voc:Relation neo4ind:sink
 neo4ind:Ismail neo4voc:name "Ismail" ;
 a neo4voc:Narrator;
 neo4voc:ID "" .
 neo4voc:Relation neo4ind:sink
 neo4ind:sink neo4voc:name "Sink" ;
 a neo4voc:Sink;
 neo4voc:ID "" .
 neo4ind:first neo4voc:name "First" ;
 a neo4voc:First;
 neo4voc:ID "" .
 neo4voc:First_Name{First_Name:Asma} neo4ind:Asma
 neo4voc:First_Name{First_Name:Fatima} neo4ind:Fatima

neo4voc:First_Name{First_Name:Hisham} neo4ind:Hisham
 neo4voc:First_Name{First_Name:Yahya} neo4ind:Yahya
 neo4voc:First_Name{First_Name:Mohammad}
 neo4ind:Mohammad
 neo4voc:First_Name{First_Name:Ismail} neo4ind:Ismail
 neo4voc:First_Name{First_Name:Ismail} neo4ind:Malik
 neo4ind:last neo4voc:name "Last" ;
 a neo4voc:Last;
 neo4voc:ID "" .
 neo4voc:Last_Name{Last_Name:Abi Baker} neo4ind:Asma
 neo4voc:Last_Name{Last_Name:Almunther }
 neo4ind:Fatima
 neo4voc:Last_Name{Last_Name:Orwa} neo4ind:Hisham
 neo4voc:Last_Name{Last_Name:Said } neo4ind:Yahya
 neo4voc:Last_Name{Last_Name:Almuthana }
 neo4ind:Mohammad
 neo4voc:Last_Name{Last_Name: Abdullah} neo4ind:Ismail
 neo4voc:Last_Name{Last_Name: Anas} neo4ind:Malik
 neo4ind:balad neo4voc:name "Balad" ;
 a neo4voc:Balad;
 neo4voc:ID "" .
 neo4voc:Balad{Balad:Makka,Madina} neo4ind:Asma
 neo4voc:Balad{Balad:Makka,Madina} neo4ind:Fatima
 neo4voc:Balad{Balad: Madina, Baghdad} neo4ind:Hisham
 neo4voc:Balad{Balad:Basra } neo4ind:Yahya
 neo4voc:Balad{Balad:Basra } neo4ind:Mohammad
 neo4voc:Balad{Balad:Madina } neo4ind:Ismail
 neo4voc:Balad{Balad:Madina } neo4ind:Malik
 neo4ind: deathdate neo4voc:name "death_Date" ;
 a neo4voc: death_Date;
 neo4voc:ID "" .
 neo4voc: Death_Date{ Death_Date:73} neo4ind:Asma
 neo4voc: Death_Date{ Death_Date:101 } neo4ind:Fatima

neo4voc: Death_Date{ Death_Date:144 } neo4ind:Hisham
 neo4voc: Death_Date{ Death_Date: 198} neo4ind:Yahya
 neo4voc: Death_Date{ Death_Date:252 }
 neo4ind:Mohammad
 neo4voc: Death_Date{ Death_Date: 226} neo4ind:Ismail
 neo4voc: Death_Date{ Death_Date:179 } neo4ind:Malik
 neo4ind: deathplace neo4voc:name "death_Place" ;
 a neo4voc: death_Place;
 neo4voc:ID "" .
 neo4voc: Death_Place{ Death_Place:Makka} neo4ind:Asma
 neo4voc: Death_Place{ Death_Place:Madina}
 neo4ind:Fatima
 neo4voc: Death_Place{ Death_Place:Baghdad }
 neo4ind:Hisham
 neo4voc: Death_Place{ Death_Place:Basra} neo4ind:Yahya
 neo4voc: Death_Place{ Death_Place:Basra}
 neo4ind:Mohammad
 neo4voc: Death_Place{ Death_Place:Madina} neo4ind:Ismail
 neo4voc: Death_Place{ Death_Place:Madina} neo4ind:Malik
 neo4ind: birthdate neo4voc:name "birth_date" ;
 a neo4voc:birth_date;
 neo4voc:ID "" .
 neo4voc: Birth_Date{ Birth_Date:1} neo4ind:Asma
 neo4voc: Birth_Date{ Birth_Date:48} neo4ind:Fatima
 neo4voc: Birth_Date{ Birth_Date: 61} neo4ind:Hisham
 neo4voc: Birth_Date{ Birth_Date:120 } neo4ind:Yahya
 neo4voc: Birth_Date{ Birth_Date:167 } neo4ind:Mohammad
 neo4voc: Birth_Date{ Birth_Date:139 } neo4ind:Ismail
 neo4voc: Birth_Date{ Birth_Date:93} neo4ind:Malik
 neo4ind: birthplace neo4voc:name "birth_place" ;
 a neo4voc:birth_place;
 neo4voc:ID "" .
 neo4voc: Birth_Palce{ Birth_Palce:Madina} neo4ind:Asma

```

neo4voc: Birth_Palce{ Birth_Palce:Null} neo4ind:Fatima
neo4voc: Birth_Palce{ Birth_Palce:Madina }
neo4ind:Hisham
neo4voc: Birth_Palce{ Birth_Palce: Null} neo4ind:Yahya
neo4voc: Birth_Palce{ Birth_Palce: Null}
neo4ind:Mohammad
neo4voc: Birth_Palce{ Birth_Palce:Null } neo4ind:Ismail
neo4voc: Birth_Palce{ Birth_Palce: Madina} neo4ind:Malik
neo4ind: qunia neo4voc:name "Qunia" ;
a neo4voc:Qunia;
neo4voc:ID "" .
neo4voc: Qunia{Qunia: Um Abdullad} neo4ind:Asma
neo4voc: Qunia{Qunia: Null} neo4ind:Fatima
neo4voc: Qunia{Qunia:Abu Almunther } neo4ind:Hisham
neo4voc: Qunia{Qunia: Abu Said} neo4ind:Yahya
neo4voc: Qunia{Qunia: Abu Musa} neo4ind:Mohammad
neo4voc: Qunia{Qunia: Abu Abdullah } neo4ind:Ismail
neo4voc: Qunia{Qunia: Abu Abdullah} neo4ind:Malik

```

Execution time for searching in ontology and database

Figure 7.4

Search time for the word ablution in matan

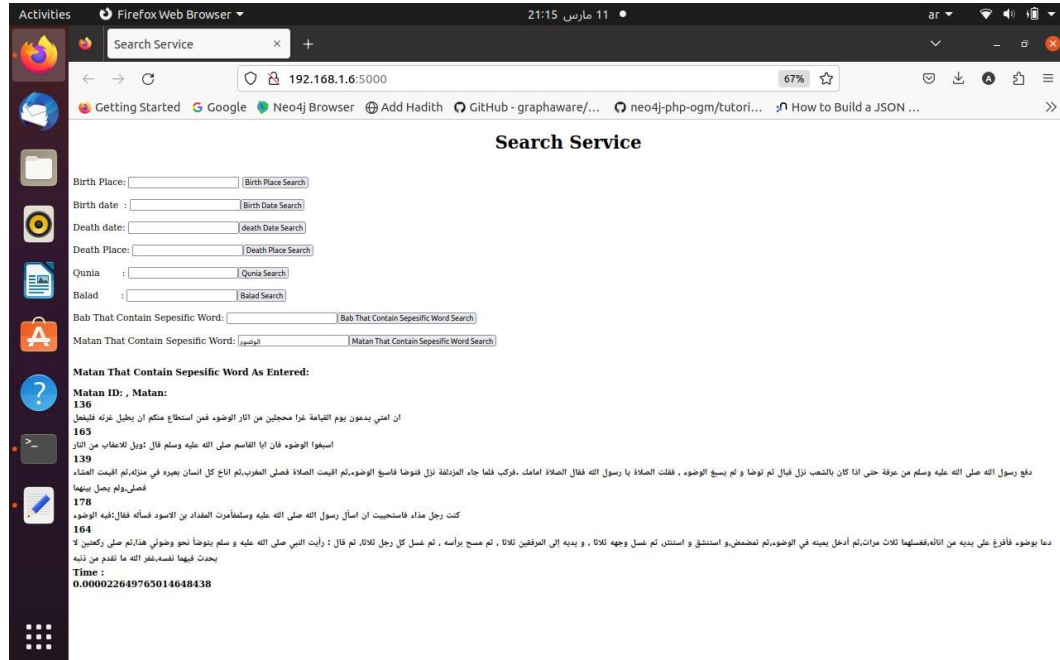


Figure 7.4 display the result for word “الوضوء” search in matan and appear the execution time.

Figure 7.5

Search for the word ablution in bab

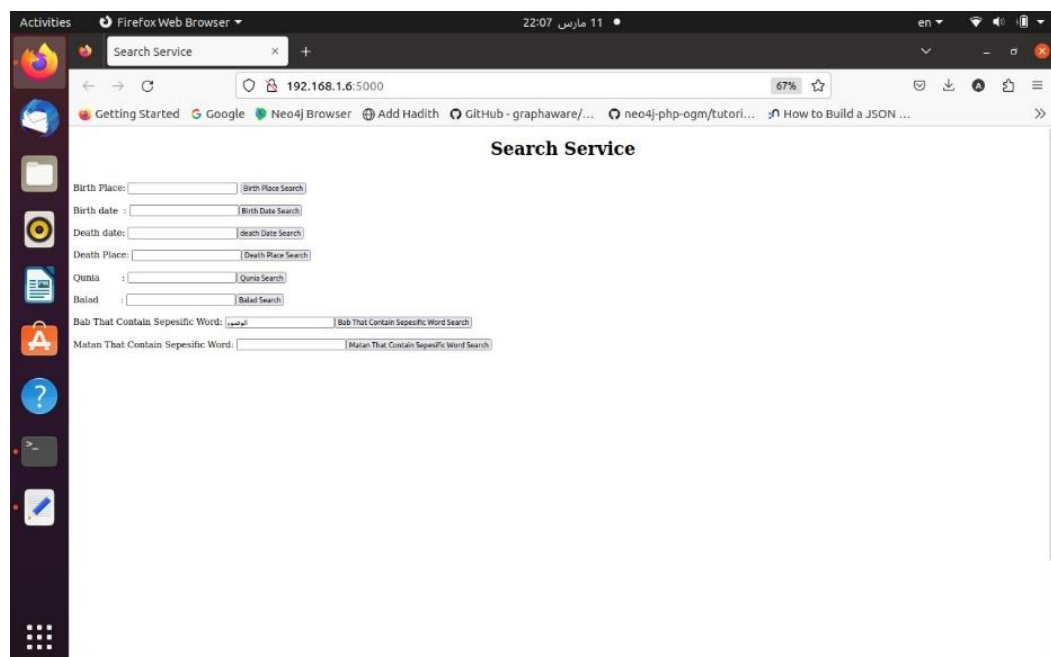


Figure 7.6

Search time for the word ablution in bab

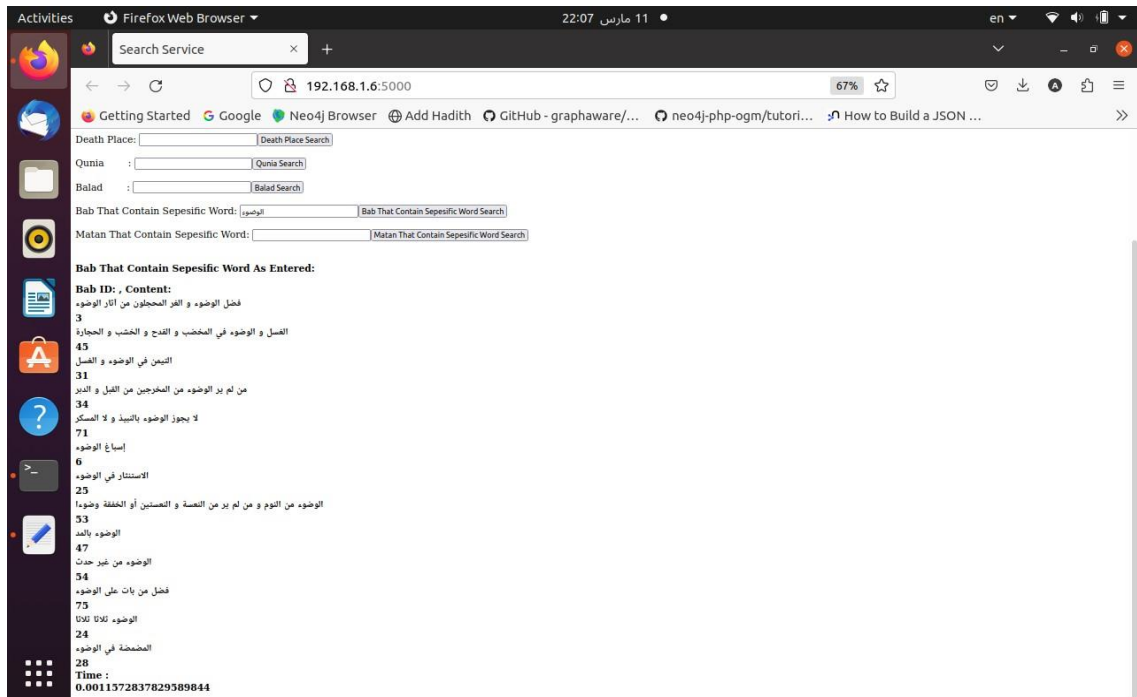


Figure 7.5, 7.6 displays the result for word “الوضوء” search in bab and appear the execution time.

Figure 7.8

Search time for the word “Almaghrib” in bab

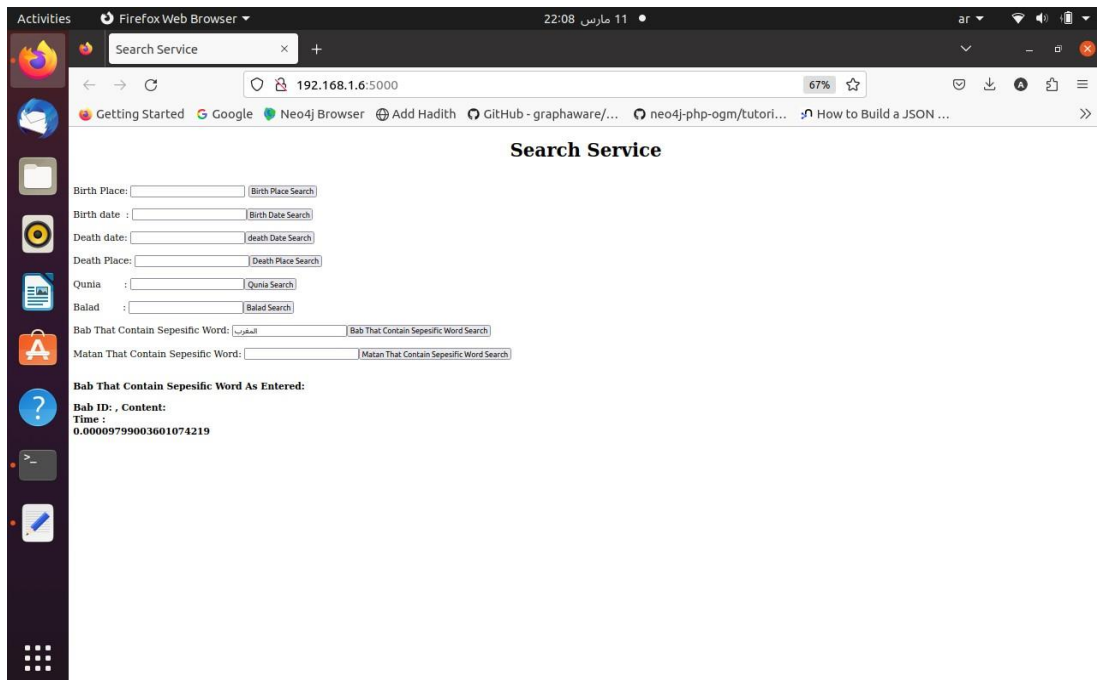


Figure 7.8 show the result for word “المغرب” search in bab and appear the execution time.

Figure 7.9

Search for the word “Rasoul” in matan

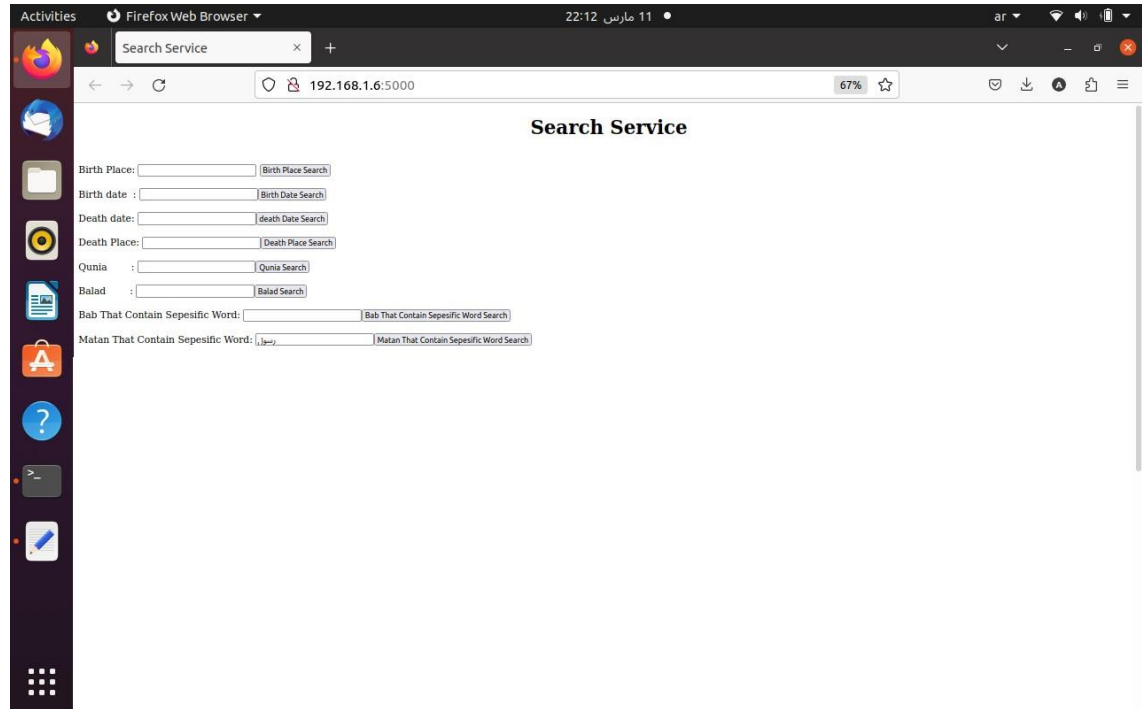


Figure 7.10

Search time for the word “Rasoul ” in matan

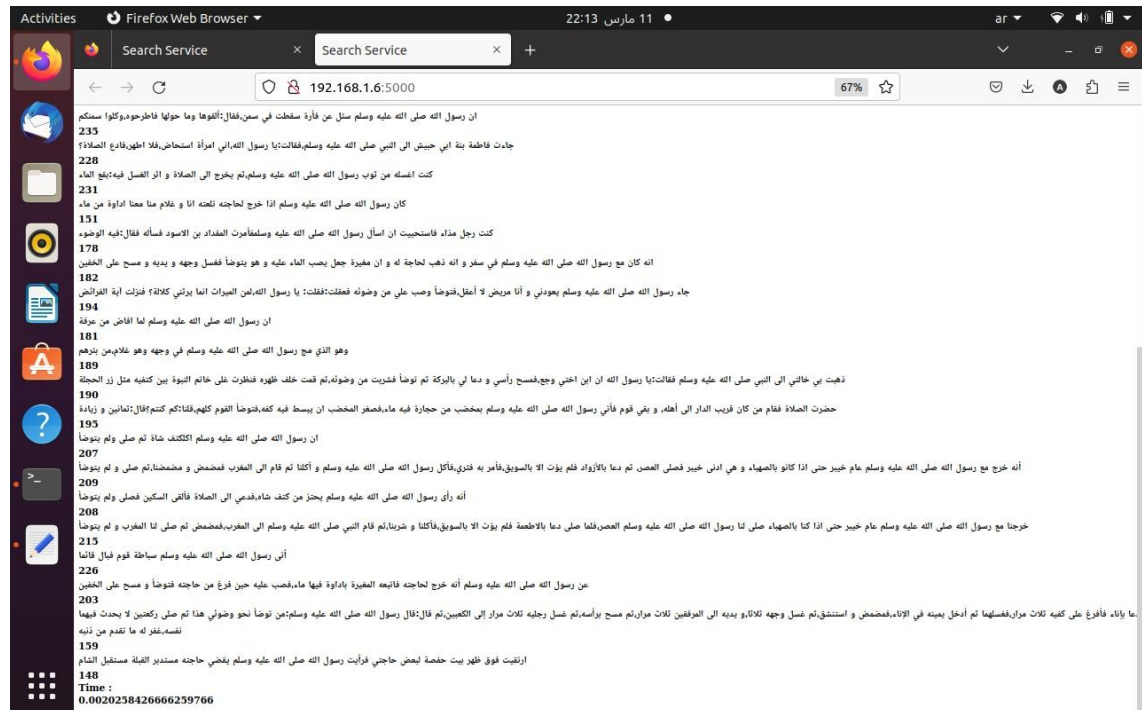


Figure 7.9, 7.10 display the result for word “رسول” search in matan and show the execution time.

Figure 7.11

Search time for the word “Man” in matan

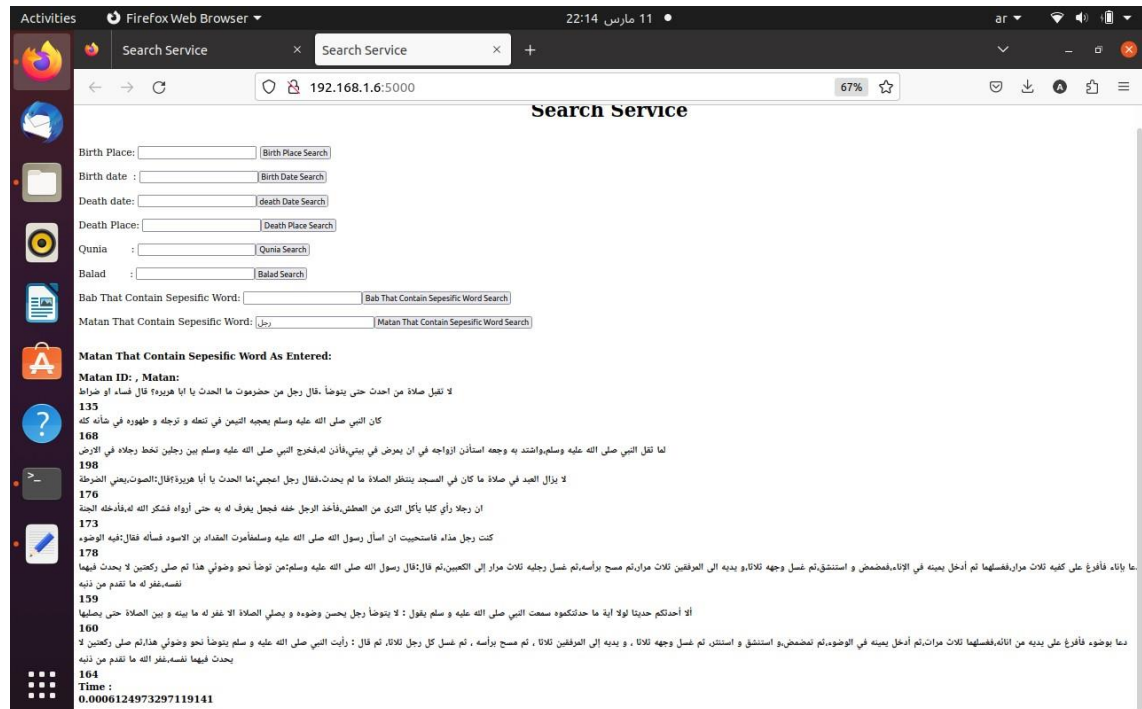


Figure 7.11 display the result for word “رجل”search in matan and the execution time.

Figure 7.12

Execution time for searching from DB

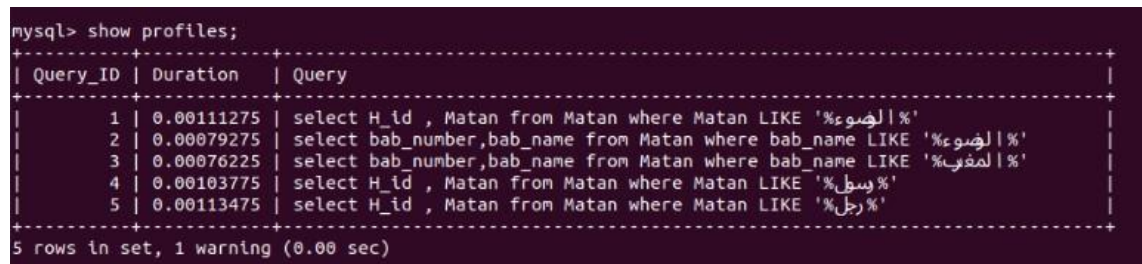


Figure 7.12 display the execution time for mysql query.

Appendix C

Figures

Figure 5.7

Delete hadith interface

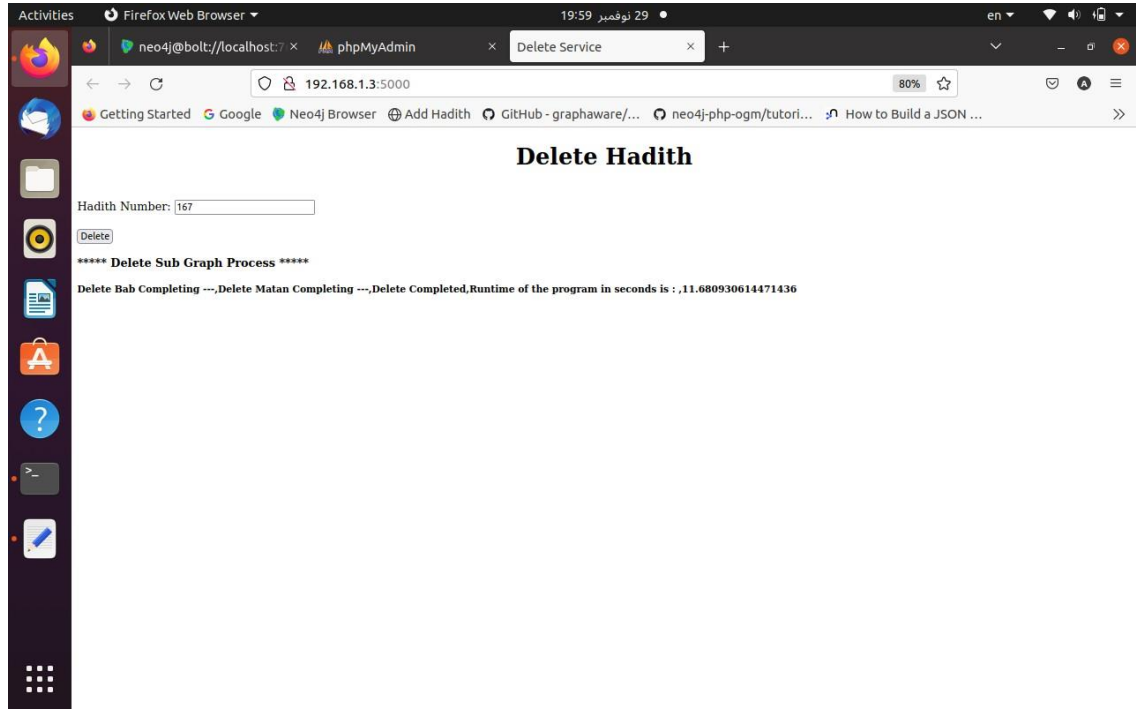


Figure 5.8

Deployment Diagram

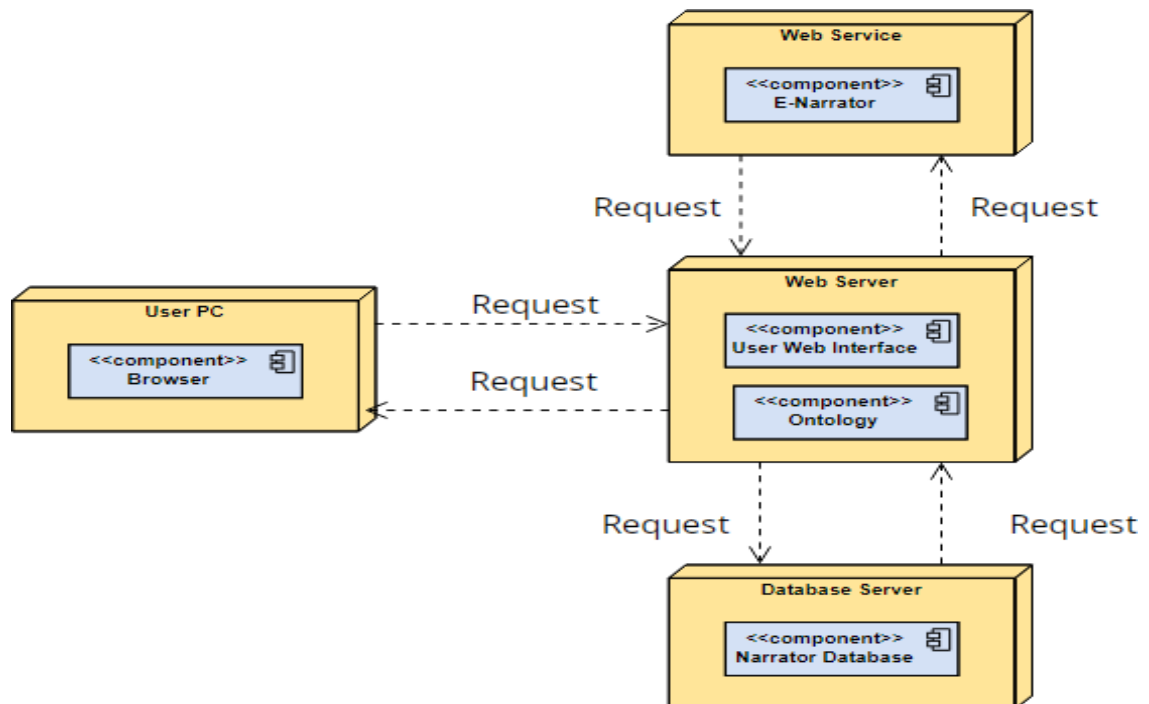


Figure 5.9
Sequence Diagram

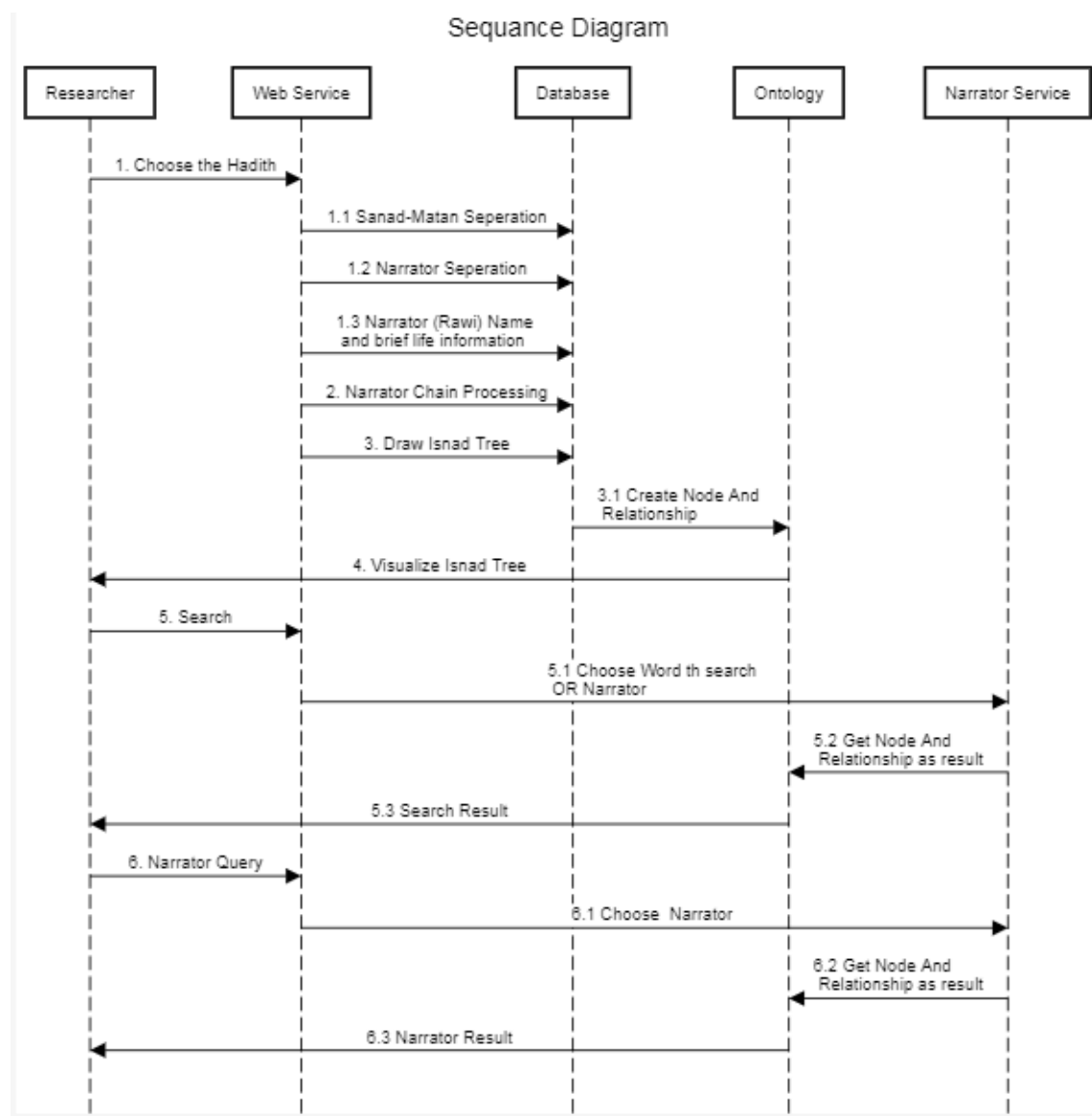


Figure 5.10

Add hadith interface

Activities Firefox Web Browser 08:39 مايو 30 en

Add Hadith Form

localhost:5000

اضافة حديث

اسم الراوي الأول	اسم والد الراوي	المتن	رقم الحديث
مكان الولادة	مكان الوفاة	رقم الباب	اسم الباب
تاريخ الميلاد	تاريخ الوفاة	إضافة راوي	
الكنية	ادارة الاخبار		

Submit

Figure 5.11

Add hadith interface special-case

Activities Firefox Web Browser 12:33 يونيو 6 ar

neo4j@bolt://localhost:7 Add Hadith Form Add Hadith Form

file:///home/abc/Desktop/templates/s_caseindex.html

اضافة حديث(حالات خاصة ، التحويل)

اسم الراوي الأول	اسم والد الراوي	المتن	رقم الحديث
مكان الولادة	مكان الوفاة	رقم الباب	اسم الباب
تاريخ الميلاد	تاريخ الوفاة	إضافة راوي	
الكنية	ادارة الاخبار		

Submit

Figure 5.12

Narrator input to narrator web service

Narrator Query

Narrator First Name : عائشه

Narrator Father Name : ابي بكر

Relation Between Rawi And Sink	Relation Between Rawi And Source	Rawi Student	Rawi Sheikh
Main Madar	Sub Madar	Itisal & Inqita3	The journey in seeking knowledge
Hadith ID that the Rawi Narrate	The TOTAL Number of Ahadith	Tabaqa	Musnad OR Mu3alaq

1) Relation Between Narrator And Sink Result:
No Relation between Sink And Narrator Found

2) Relation Between Narrator And Source Result:
Relation Found between Source And Narrator

3.1) Rawi Student Result:
سليمان يسار, ابو سلمه عبد الرحمن, عروه الزبير, عبيد الله عبد الله, مسروق الاخدع

3.2) Rawi Sheikh Result:
الرسول صلى الله عليه وسلم

4.1) Main Madar Result:
MAIN-Madar

Figure 5.13

Narrator information search result

Search Service

Birth Place: واسط Birth Place Search

Birth date : Birth Date Search

Death date: death Date Search

Death Place: Death Place Search

Qunia : ابو هريرة Qunia Search

Balad : Balad Search

Bab That Contain Sepesific Word: Bab That Contain Sepesific Word Search

Matan That Contain Sepesific Word: Matan That Contain Sepesific Word Search

Run Time Run Time

Narrators who's Birth Place As Entered:
شعبه الحاجاج

Narrators who's Qunliq As Entered:
عبد الرحمن صخر

Runtime of the program in seconds is :
15.040948629379272

Figure 5.14

Results for word search in matan

The screenshot shows a web browser window with the title 'Search Service'. The address bar shows '192.168.1.3:5000'. The page has a sidebar with various icons. The main content area contains several search filters: Birth Place, Birth date, Death date, Death Place, Qunia, Balad, Bab That Contain Sepesific Word, and Matan That Contain Sepesific Word. The 'Matan That Contain Sepesific Word' filter is set to 'الوضوء'. Below the filters, the text 'Matan That Contain Sepesific Word As Entered:' is followed by a paragraph of Arabic text discussing the importance of wudu (ablution) in Islam.

Figure 5.15

Results for word search in bab

The screenshot shows the same web browser window as Figure 5.14, but the 'Bab That Contain Sepesific Word' filter is set to 'الوضوء'. The 'Matan That Contain Sepesific Word' filter is empty. Below the filters, the text 'Bab That Contain Sepesific Word As Entered:' is followed by a paragraph of Arabic text discussing the importance of wudu (ablution) in Islam.

Figure 5.16

Search for Ahadith Al-moalaq within the ontology

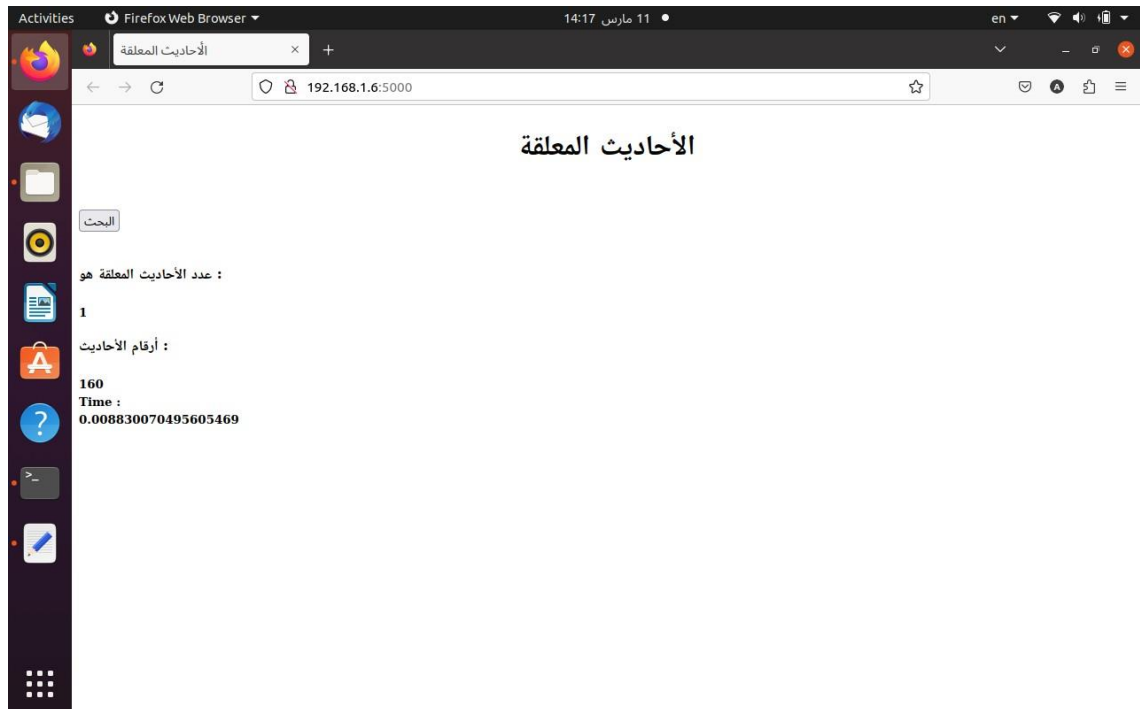


Figure 5.17

Ruwah balad query for specific hadith

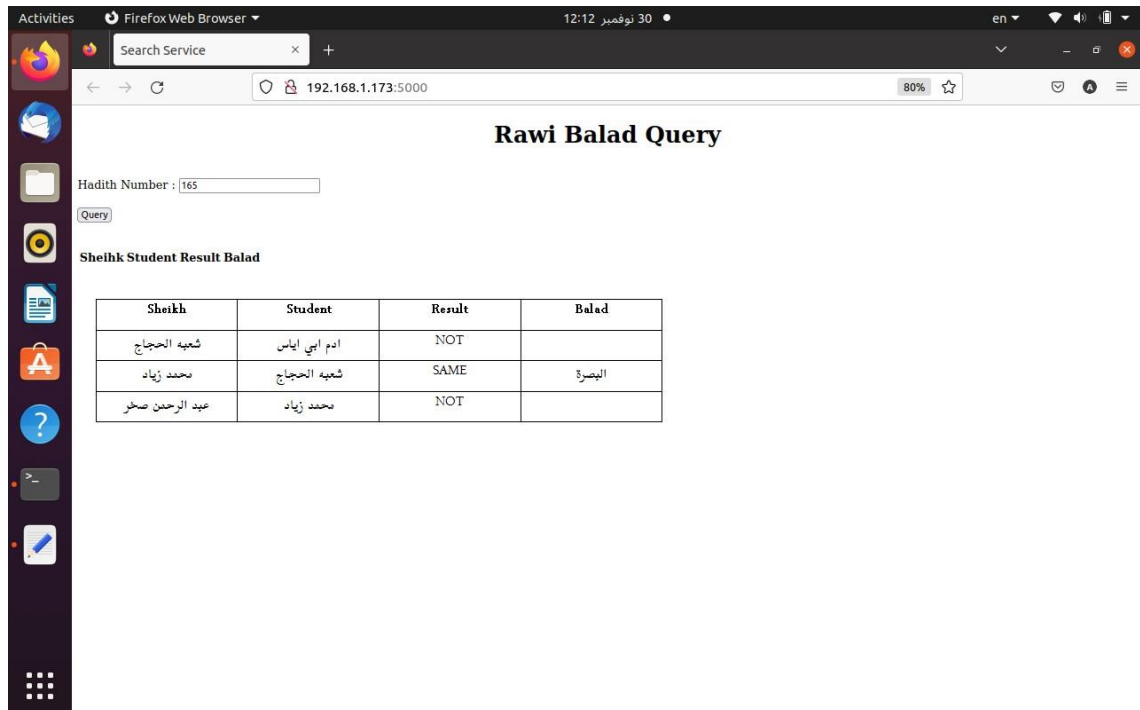


Figure 5.18

Dynamic ontology framework

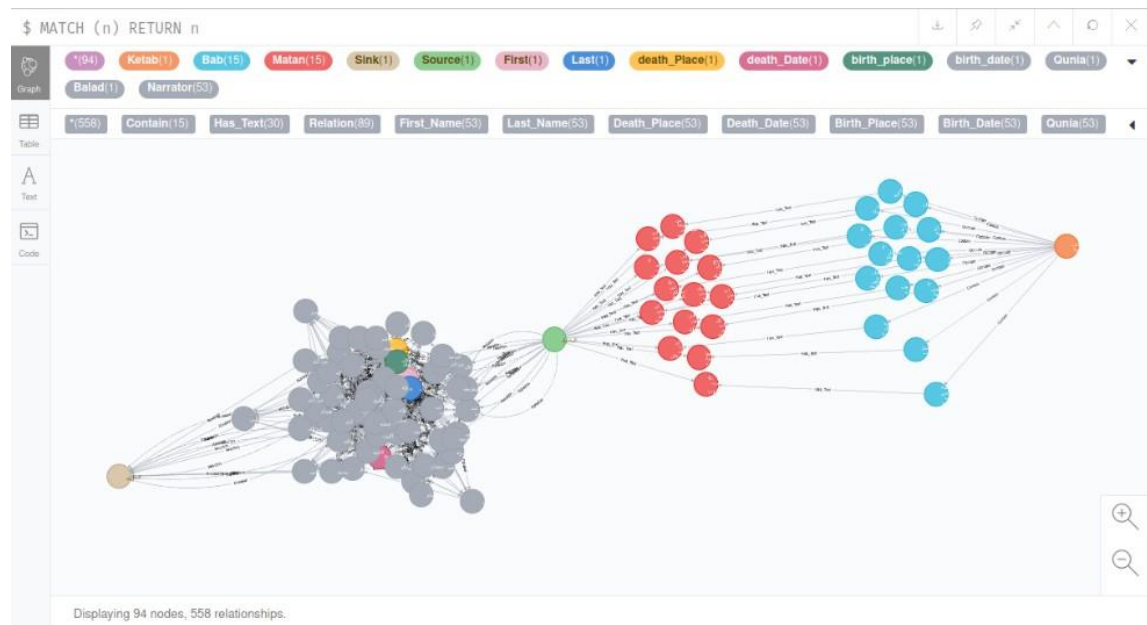


Figure 6.1

Information filled in user web interface

Figure 6.2

Submit adding hadith

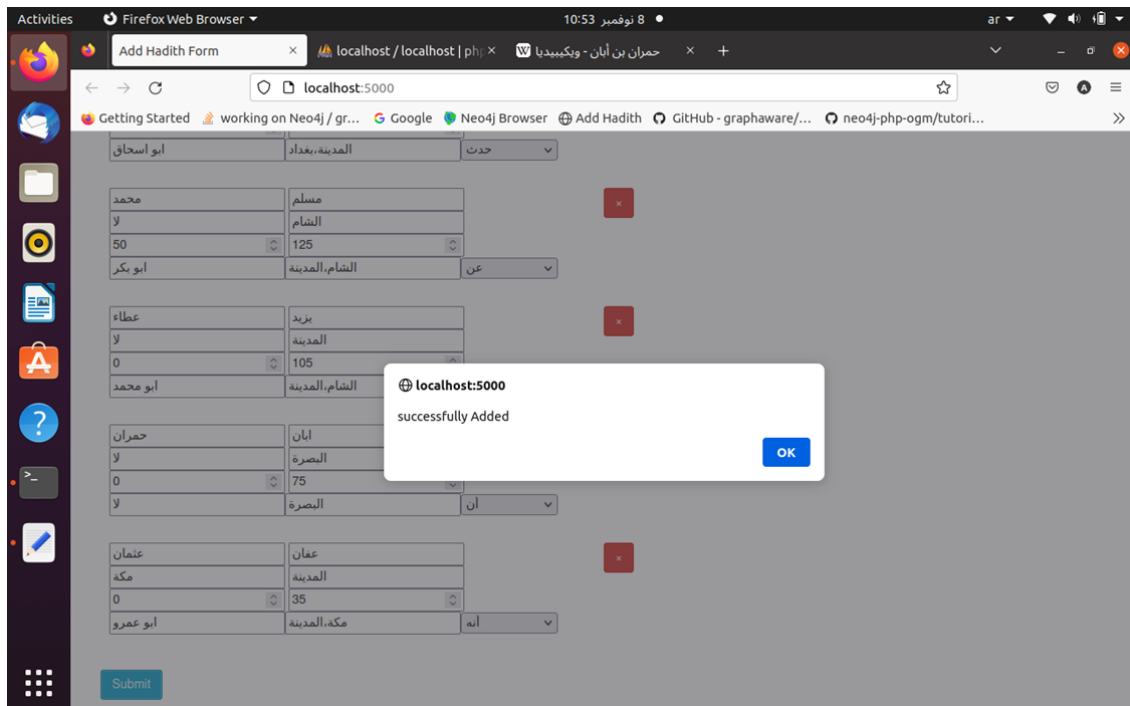


Figure 6.3

Enter hadith to database



Figure 6.4

Neo4j platform

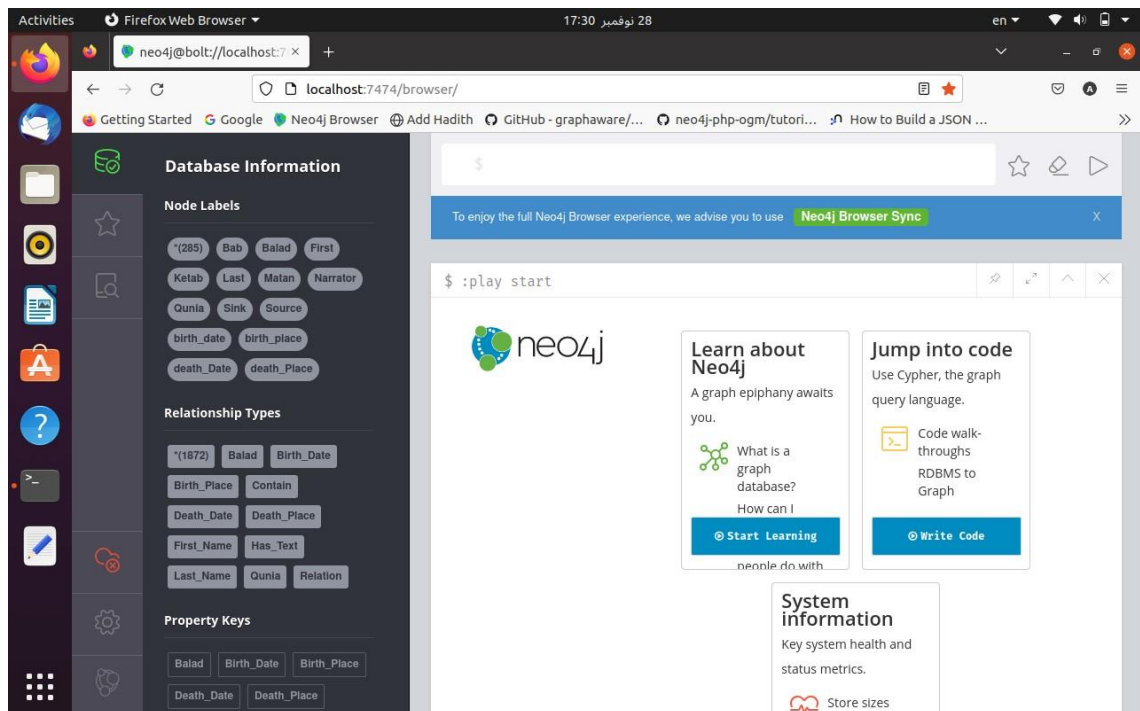


Figure 6.5

Create ketab, bab, matan nodes

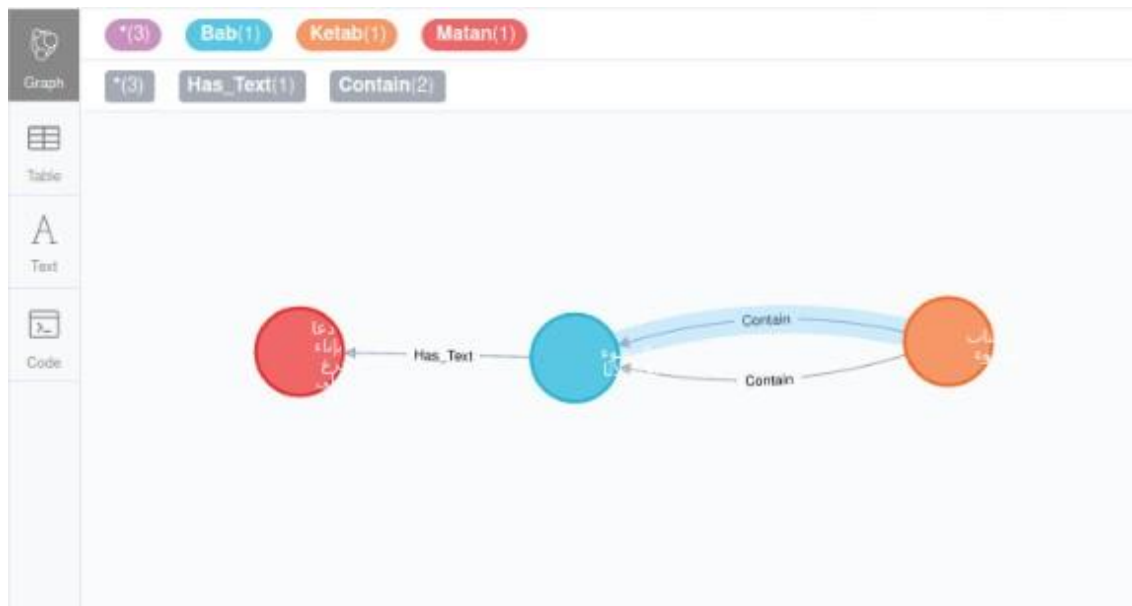


Figure 6.6

Create sink node



Figure 6.7

Create source node

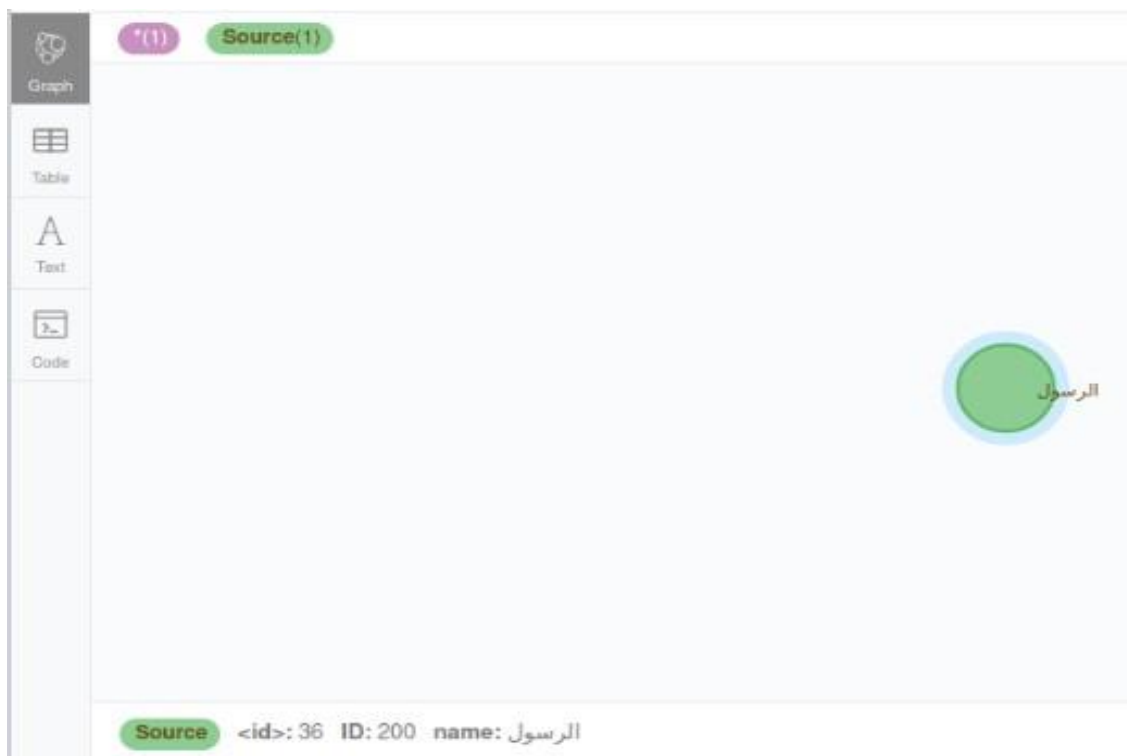


Figure 6.8

Create narrator node



Figure 6.9

Create narrator property node

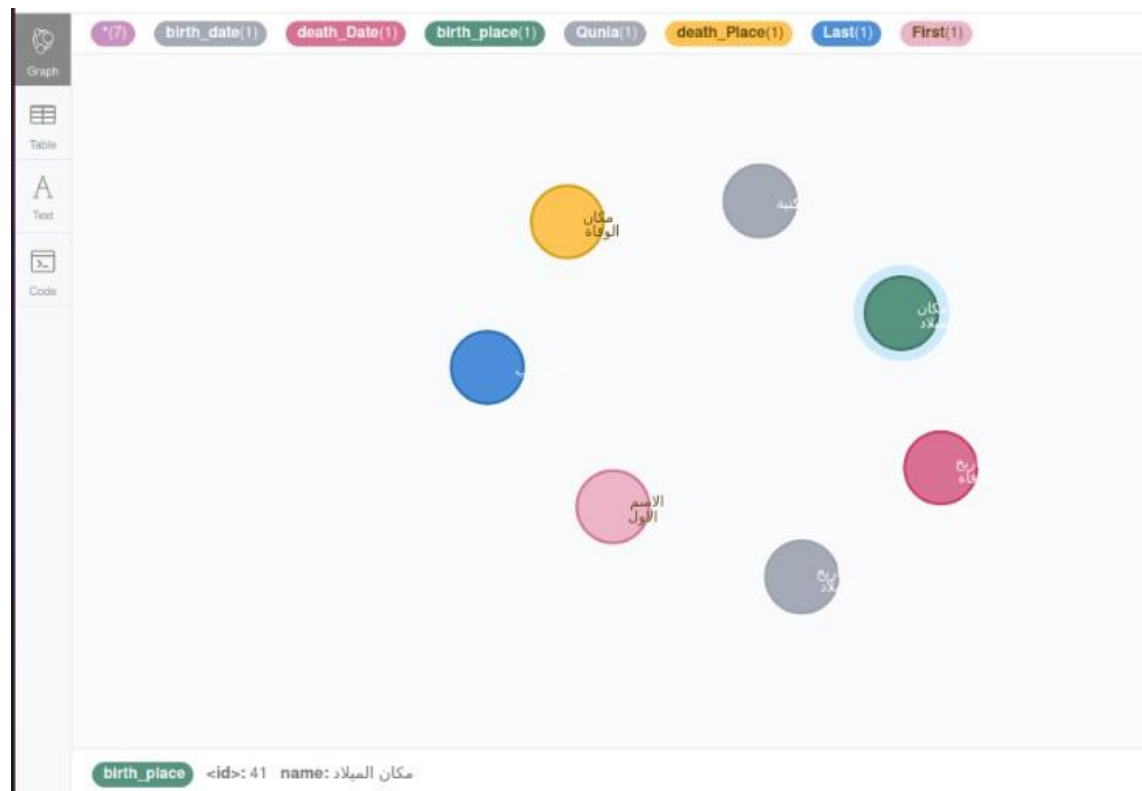


Figure 6.10

Create relation with narrator property node

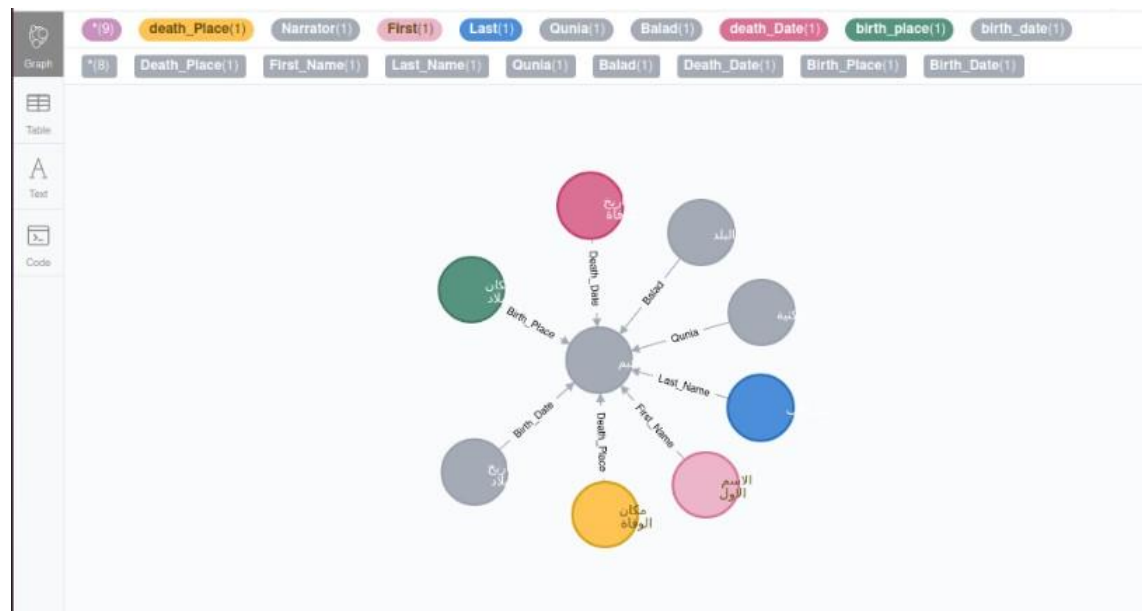


Figure 6.11

Create relation between nodes

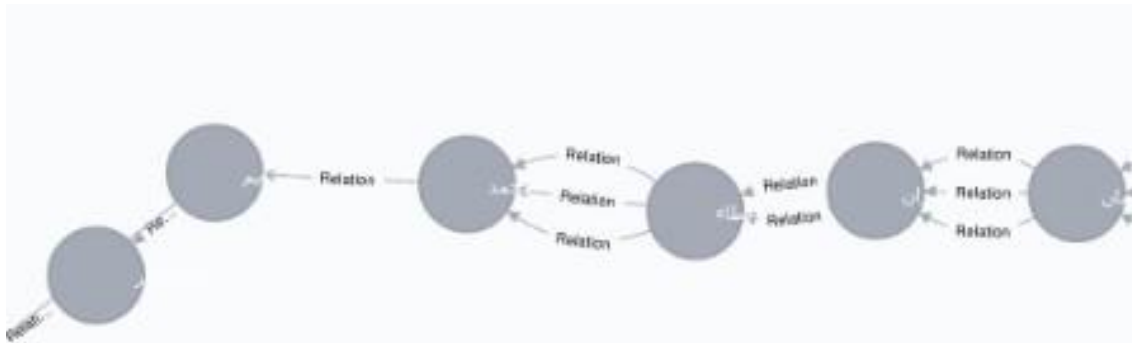


Figure 6.12

Create relation with sink node

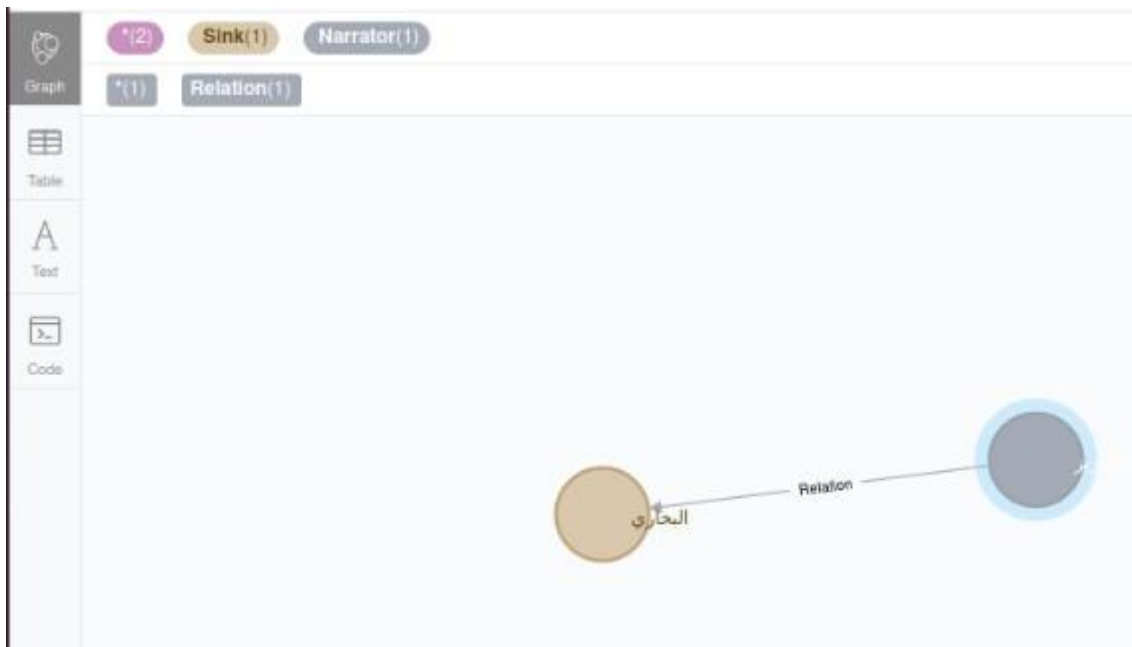


Figure 6.13

Create relation with source node

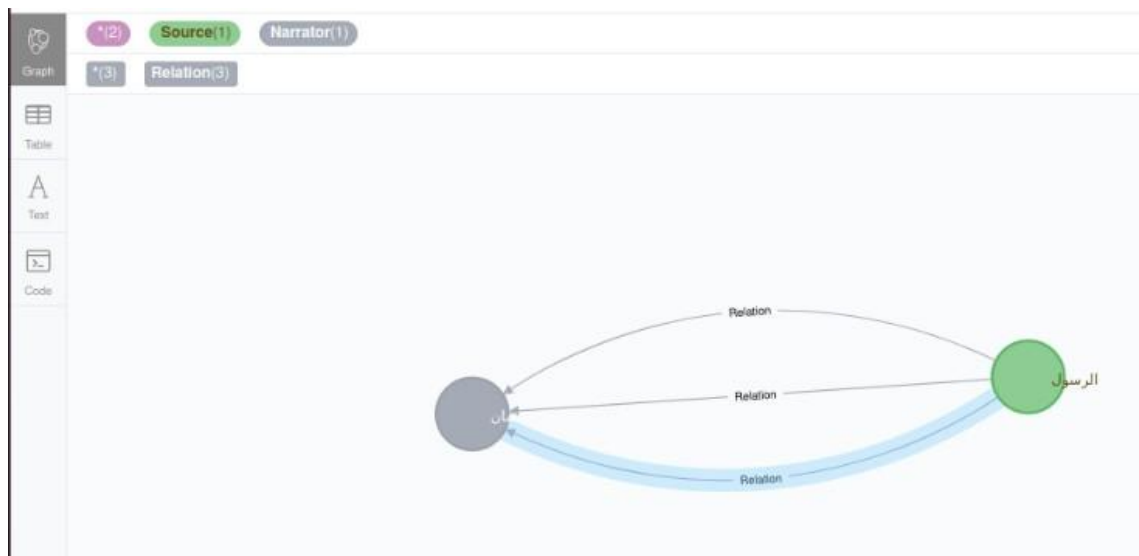


Figure 6.14

Create relation between bab and ketab

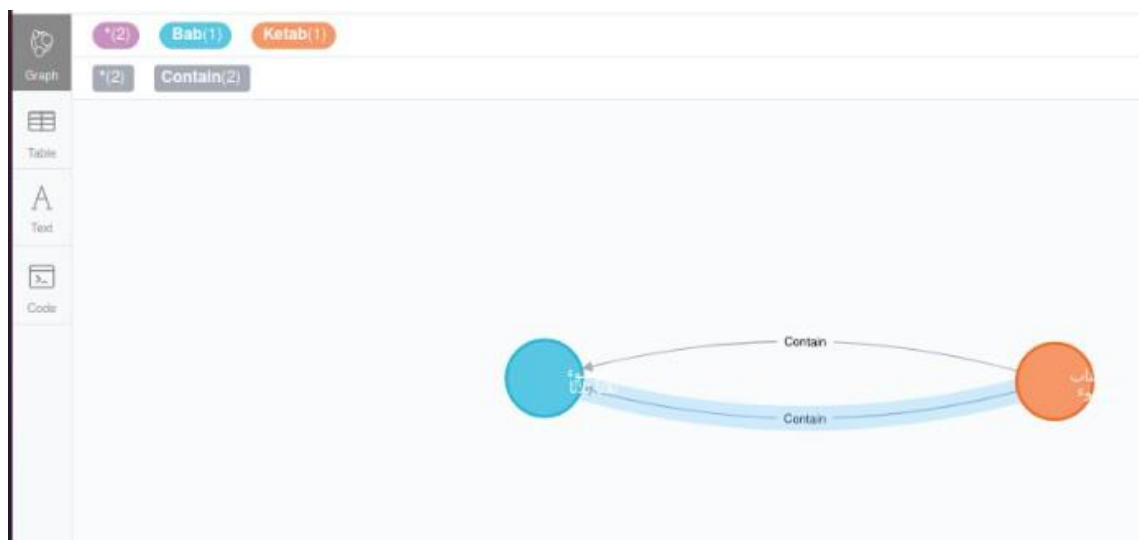


Figure 6.15

Create relation between bab and matan

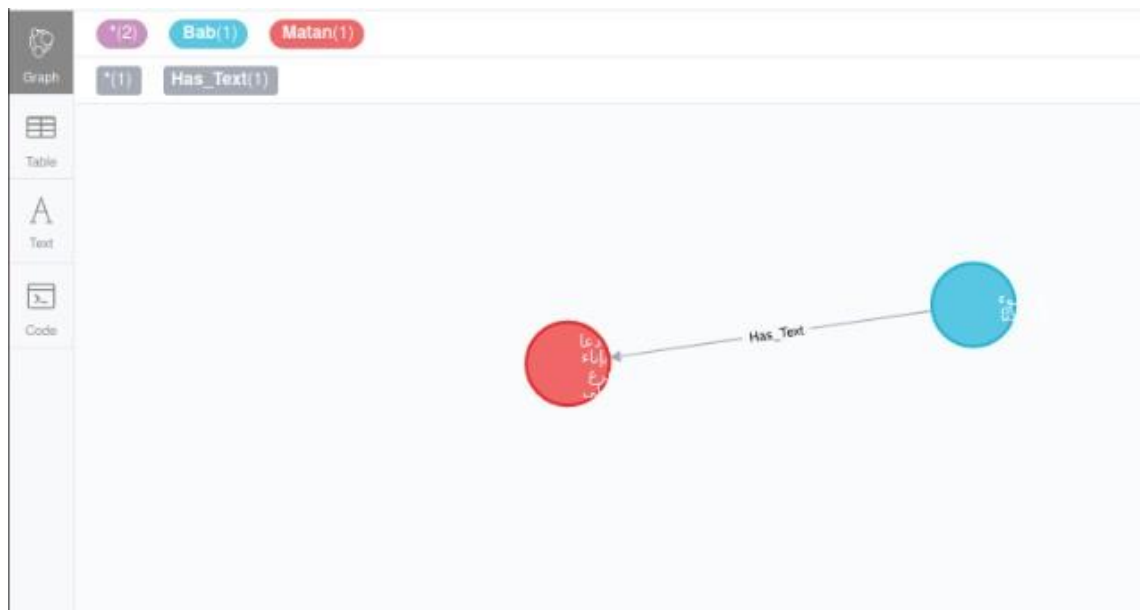


Figure 6.16

Create relation between nodes

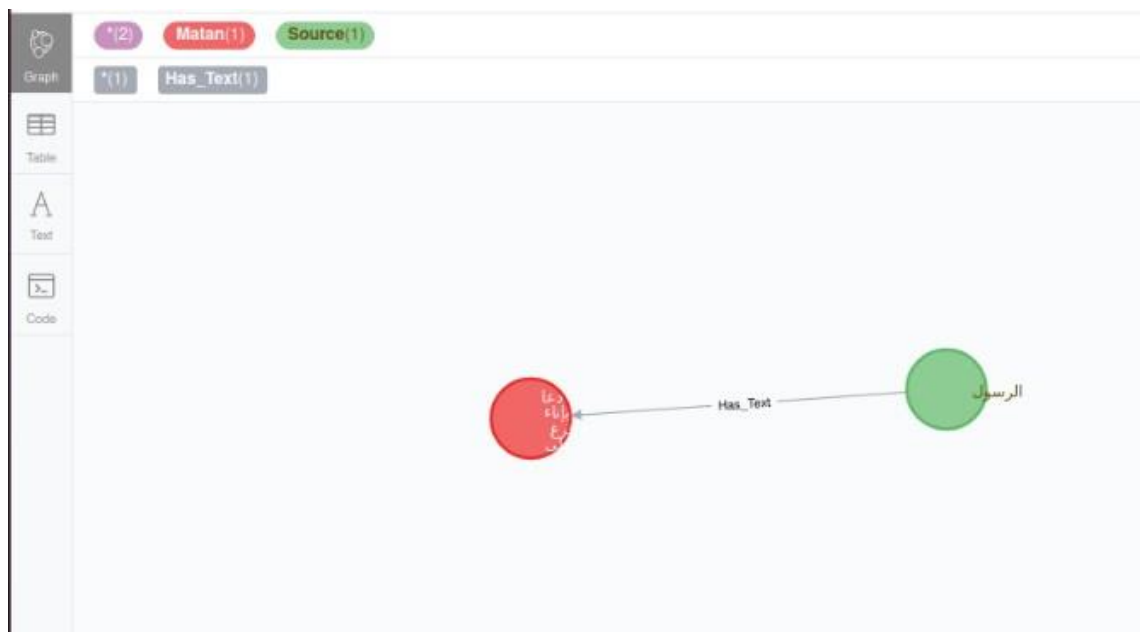


Figure 6.17

Hadith isnad tree

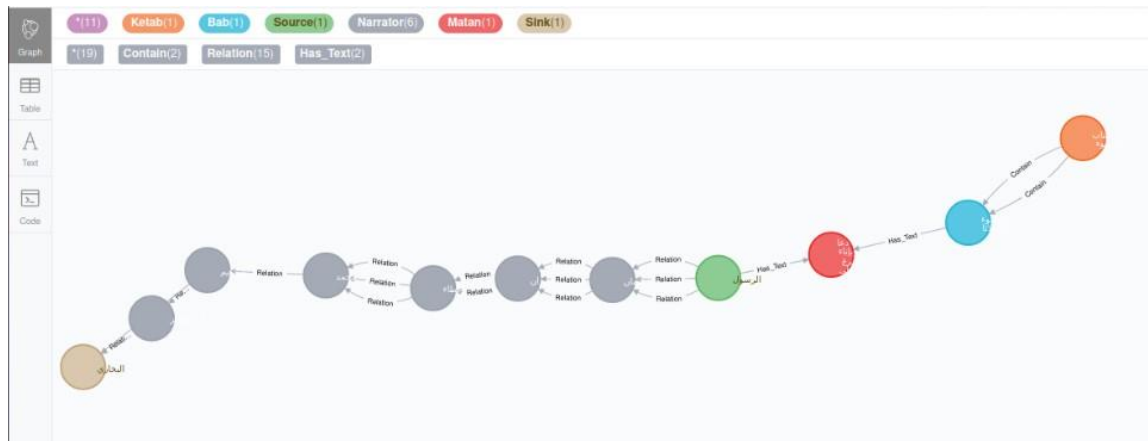


Figure 6.18

Ontology framework

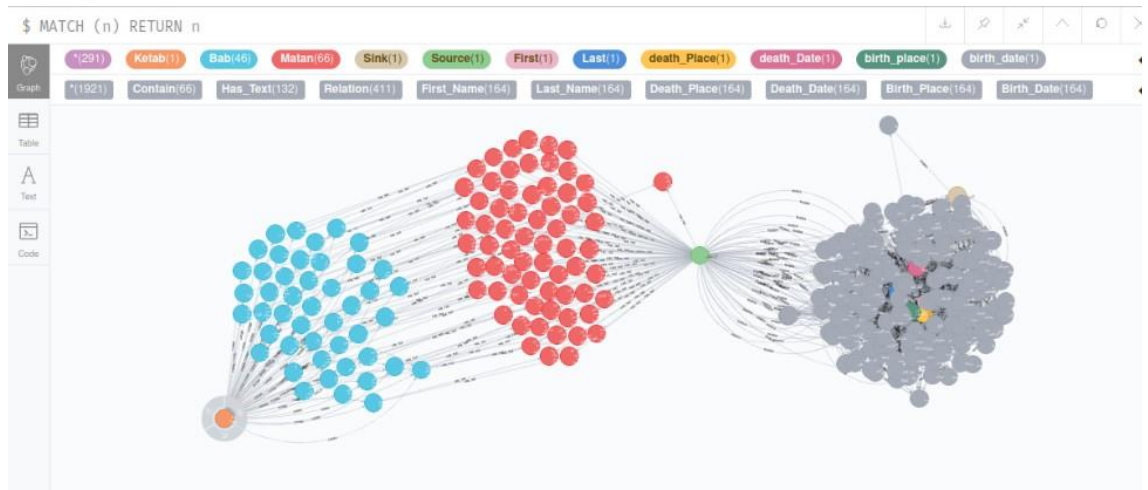


Figure 6.19

Display the hadith in the ontology

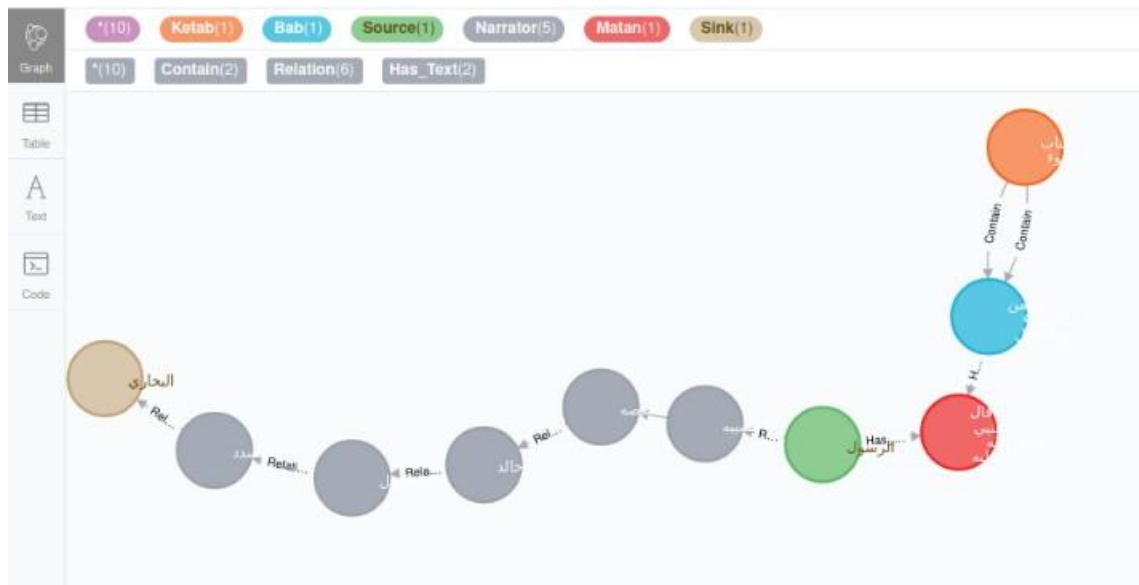


Figure 6.20

Delete hadith web interface

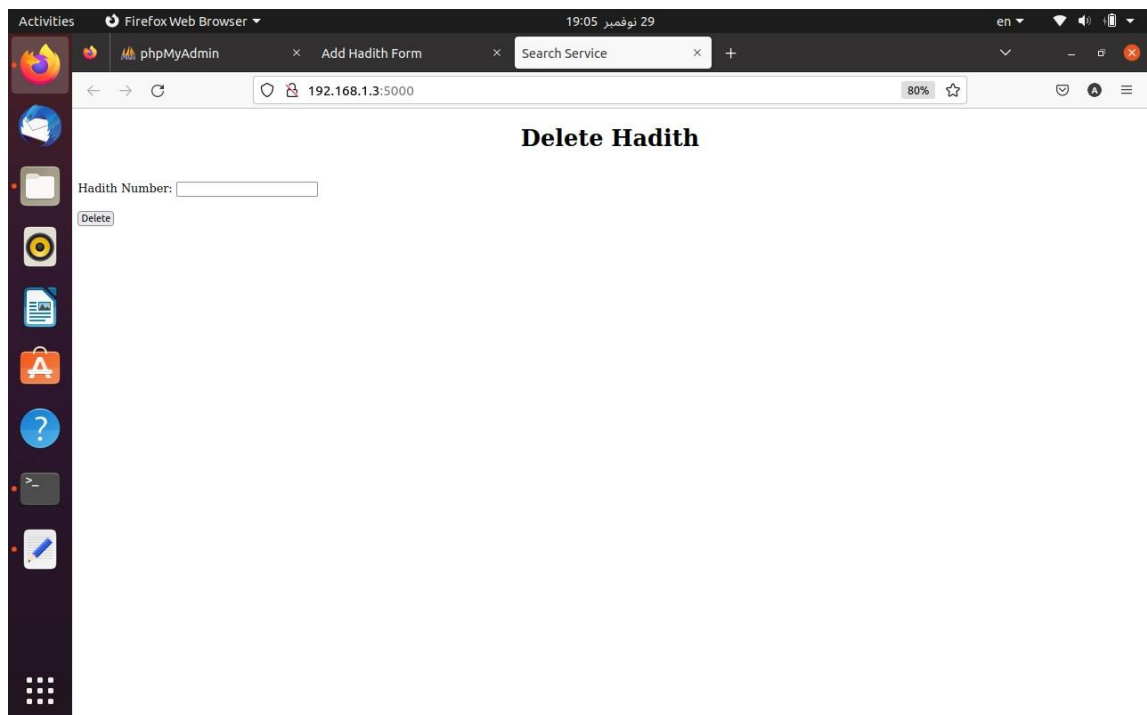


Figure 6.21

Delete process completed

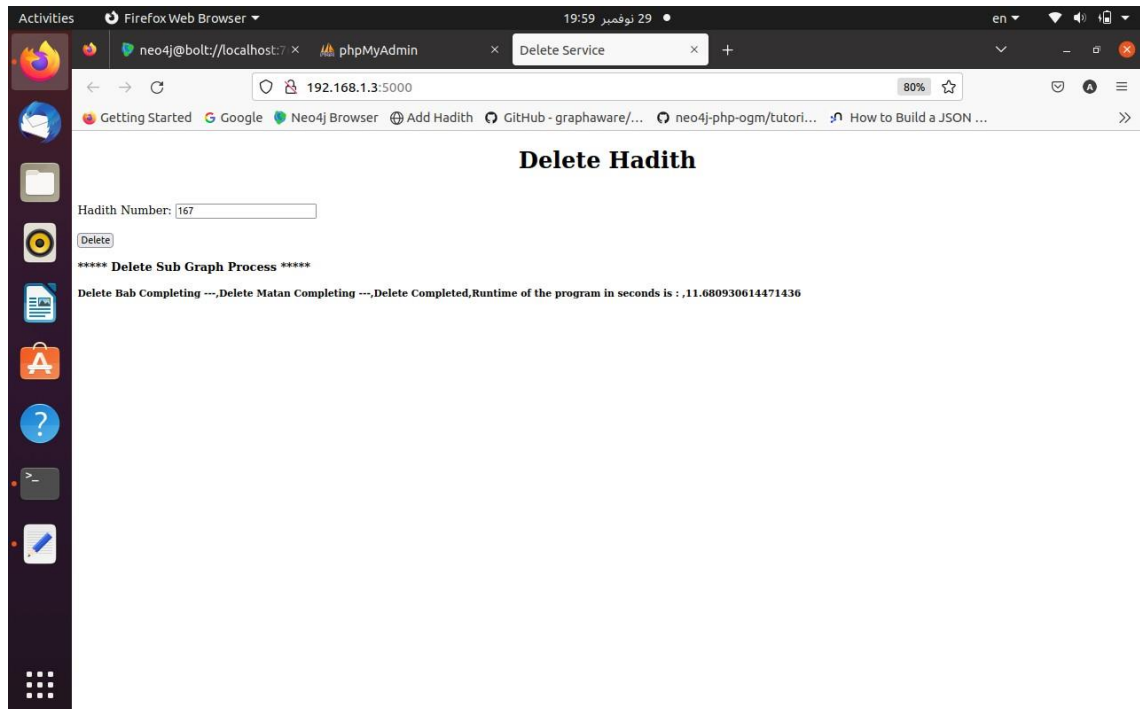


Figure 6.22

Search for hadith in ontology



Figure 7.1

Query result for Abu Huraira narrator

Narrator Query

Narrator First Name :

Narrator Father Name :

Relation Between Rawi And Sink	Relation Between Rawi And Source	Rawi Student	Rawi Sheikh
Main Madar	Sub Madar	Itisal & Inqita3	The journey in seeking knowledge
Hadith ID that the Rawi Narrate	The TOTAL Number of Ahadith	Tabaga	Musnad OR Mu3alaq

1) Relation Between Narrator And Sink Result:
No Relation between Sink And Narrator Found

2) Relation Between Narrator And Source Result:
Relation Found between Source And Narrator

3.1) Rawi Student Result:
عائذ الله عبد الله بن عبد الرحمن بن عوف بن مالك بن زيد بن كنانة بن خزيمة بن مدركة بن إلياس بن مضر بن نضلة بن معد بن عدنان بن كنانة بن خزيمة بن مدركة بن إلياس بن مضر بن نضلة بن معد بن عدنان

3.2) Rawi Sheikh Result:
الرسول صلى الله عليه وسلم

4.1) Main Madar Result:
MAIN-Madar

4.1) Sub Madar Result:
Not SUB-Madar

5) Itisal & Inqita3 Result:

Figure 7.2

System query result

Narrator Query

Narrator First Name :

Narrator Father Name :

Relation Between Rawi And Sink	Relation Between Rawi And Source	Rawi Student	Rawi Sheikh
Main Madar	Sub Madar	Itisal & Inqita3	The journey in seeking knowledge
Hadith ID that the Rawi Narrate	The TOTAL Number of Ahadith	Tabaga	Musnad OR Mu3alaq
Run Time			

System query results complement



Run time for manual searching



Figure 7.14

Run time for searching in Alshamela library

صحيح البخاري
39
1

مستعمل	النص	الكتاب	الباب	الجزء	الصفحة
5	فصل الوضوء ولغير المحتضن من أكثر	صحيح البخاري	باب فضل الوضوء ولغير المحتضن من أكثر	1	39
6	الله عليه وسلم يقول إن أمتي يدين يوم القيامة غرا محجلين من أكثر الوضوء فمن استطاع منكم أن يطيل غرته فليطيل ثم أخرجه	صحيح البخاري	باب فضل الوضوء، ولغير المحتضن من أكثر	1	39
7	التخفيف فيه	صحيح البخاري	باب التخليف في الوضوء	1	39
8	إصباح	صحيح البخاري	باب إصباح الوضوء	1	40
9	أين عمر إصباح الوضوء	صحيح البخاري	باب إصباح الوضوء	1	40
10	عليه وسلم من غرة حتى إذا كان بالشعب نزل نزل لم توضع ولم يسمع الوضوء فقلت الصلاة يا رسول الله فقال الصلاة أمأنتك	صحيح البخاري	باب إصباح الوضوء	1	40
11	الوضوء مرة	صحيح البخاري	باب الوضوء مرة مرة	1	43
12	الوضوء مرتين	صحيح البخاري	باب الوضوء مرتين مرتين	1	43
13	الوضوء ثلاثا	صحيح البخاري	باب الوضوء ثلاثا ثلاثا	1	43
14	ما أنزلنا من الدين البقرة ثم أخرجه مسلم في الطهارة باب صفة الوضوء وكيفية رتم ثلاث مرات نحو وفوتني هذا مثل هذا	صحيح البخاري	باب الوضوء ثلاثا ثلاثا	1	43

تحت ملاحظة البحث
كتاب 1 / 1
النتائج: 36

⌂ TIMER
⏸ STOPWATCH

7s 81

START
RESET

Appendix D

Tables

Table 7.7

Research papers for Ahadith representation

Paper Name	Main Objective	Source of knowledge	Developing Ontology	Sanad/Matan Represents
Creation of Arabic Ontology for Hadith Science.	Build and implement an ontology for all concepts and main knowledge of Hadith Science.	Famous books, experts in the domain	The kernel of the ontology is created with the Protégé Editor.	Sanad
Growing Hadiths Ontology.	Build an ontology scheme (concepts, entities, and relations which was collected and determined) for a whole hadith or a part of hadith.	Riyadh As-Saliheen	Manually.	Matan
An Ontological Model of Hadith Texts.	Construction of an ontology that represents the semantics of the Arabic Hadith text in its original form, to be used for the automatic extraction of Islamic laws or laws.	Sahih El-Bukhari	Manual process.	Matan
An Ontology based approach to support Semantic Search in Hadith (Zakat Domain)	Develop ontology Hadith system, which is an ontology based system that improves the zakat Ahadith retrieval process by using semantic tools rather than keyword exact matching.	Sahih Bukhari and Muslim	Created with the Protégé Editor.	Sanad
Towards a Joint Ontology of Quran and Hadith	Implemented the ontology used to create an Islamic ontology covering the Holy Qur'an and the Noble Hadith, it compares the keywords extracted from the titles of Sahih Al-Bukhari and the concepts of the Qur'anic ontology, this provides a visualization of the overlap between the words of the Ahadith of the Prophet and the Qur'anic concepts.	Holy Qur'an, Sahih Al-Bukhari.		Matan
A Dynamic Ontological Framework for Bukhari Ahadith.	In this research we developed automated build process for dynamic ontological framework for Ahadith and Ruwah input, and the framework is able to save these Ahadith and Ruwah in the ontology and connect it with suitable links with other related Ahadith previously exist in ontology.	Sahih Bukhari specifically the Ahadith of ablution.	Automated process.	Represents both Sanad and Matan.



جامعة النجاح الوطنية
كلية الدراسات العليا

إطار أنطولوجيا ديناميكي لأحاديث البخاري

إعداد
أريج معروف صوان

إشراف
د. أمجد هواش
د. محمد الجيطان

قدمت هذه الرسالة استكمالاً لمتطلبات الحصول على درجة الماجستير في الحوسبة المتقدمة، من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس - فلسطين.

٢٠٢٣

إطار أنطولوجيا ديناميكي لأحاديث البخاري

إعداد

أريج معروف صوان

إشراف

د. أمجد هواش

د. محمد جيطان

الملخص

تعد السنة النبوية الشريفة المصدر الثاني من مصادر التشريع الاسلامي بعد القرآن الكريم، وقد اهتم علماء المسلمين بحفظ الحديث وتدوينه لما له من دور في بيان القرآن الكريم من تخصيص العموم، وتقييد المطلق، وتبيين المجهول. وقد نقلت السنة النبوية بالأسانيد (إسناد، لغة من سند (اعتمد)، في الإسلام، رفع الحديث إلى قائله. وتحدد مصداقيتها صحة الحديث) مشافهةً وهي الأغلب وكتابةً لمن أُنقن الكتابة في زمن النبوة والصحابة ثم دونت وصنفت الأحاديث بأسانيداً حتى غدت اليوم جوامع الأحاديث (الحديث، كل ما ورد عن النبي محمد صلى الله عليه وسلم من قول أو فعل أو تقرير)، مستدركات وغيرها من الكتب التي تختص بجمع وتصنيف الأحاديث.

يعد اثناء المحتوى الإلكتروني الإسلامي تحدياً كبيراً للباحثين على الرغم من أن اللغة العربية تعد لغة عالمية وتأتي بالمرتبة السادسة لأكثر اللغات استخداماً حول العالم ويتحدث بها أكثر من ٤٠٠ مليون شخص حول العالم، إلا أنه ليس لها وجود كافٍ على صفحات الانترنت مقارنة باللغات الأخرى.

تعرف الأنطولوجيا على أنها تمثيل للمعرفة والمفاهيم ضمن مجال معين، وتستخدم لتحديد وتصنيف العلاقات بين المفاهيم المختلفة.

هدفت الدراسة إلى بناء إطار أنطولوجي ديناميكي سيتمكن من خلاله المختصون بعلم الحديث من تزويده بمعلومات كافية عن الحديث بحيث تكون الأنطولوجيا قادرة على حفظ الحديث مع مراعاة ربطه مع الأحاديث

ذات الصلة والرواة الموجودين في الإطار، مما يجعل عملية استرجاع المعلومات سهلاً ومثمراً. وقد أجريت الدراسة على "كتاب الوضوء" من صحيح البخاري.

تم تقييم النظام من خلال تنفيذ عدة استعلامات حول الرواة والأحاديث وشجرة الإسناد وعند مقارنة نتائج النظام بالنتائج التقليدية والطرق الأخرى لتمثيل المعرفة حصلنا على نتائج أفضل سواء في البحث والاسترجاع، أو في رسم شجرات الإسناد، أو الوقت المستغرق في البحث عن المعلومة.

الكلمات المفتاحية: الحديث، شجرة إسناد الحديث، تمثيل المعرفة، أنطولوجيا، إطار أنطولوجي ديناميكي.