ONTOLOGY-BASED APPROACH FOR RETRIEVING KNOWLEDGE IN AL-QURAN

QUSAY ABDULLAH ABED

MASTER OF SCIENCE (INFORMATION TECHNOLOGY)
SCHOOL OF COMPUTING
COLLEGE OF ARTS AND SCIENCES
UNIVERSITI UTARA MALAYSIA
2015
Permission to Use

In presenting this thesis in fulfilment of the requirements for a postgraduate degree from Universiti Utara Malaysia, I agree that the Universiti Library may make it freely available for inspection. I further agree that permission for the copying of this thesis in any manner, in whole or in part, for scholarly purpose may be granted by my supervisor(s) or, in their absence, by the Dean of Awang Had Salleh Graduate School of Arts and Sciences. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to Universiti Utara Malaysia for any scholarly use which may be made of any material from my thesis.

Requests for permission to copy or to make other use of materials in this thesis, in whole or in part, should be addressed to:

Dean of Awang Had Salleh Graduate School of Arts and Sciences
UUM College of Arts and Sciences
Universiti Utara Malaysia
06010 UUM Sintok
Abstrak


Abstract

Information retrieval relies on obtaining relevant data from a set of knowledge resources, such as Al-Quran. Searching can be based on metadata, indexing, or other content-based. Al-Quran is the most widely read book in the world and automating knowledge retrieval from this of religious literature is very challenging. This has led to the development of a number of search applications, which can retrieve knowledge based on keywords. Retrieving the knowledge of Al-Quran ontology includes several fundamental problems, one of which is the lack of accuracy. In most cases, the searching cannot retrieve the relevant concept of knowledge and verses. Current approaches use conventional methods such as taxonomy, hierarchy, or tree structure, which only provide the definition of the concept of themes without linking to the correct knowledge concept of Al-Quran. The main aim of this study is to design a method that uses the ontology approach to search and retrieve relevant verses in Al-Quran. The new approach consists of two stages. The first stage: involves the Al-Quran ontology development based on thematic classification which was implemented using Protégé-OWL. The second stage: involves the development of a search method by using the Jena framework which is based on Java programming languages. The search method allows ontology processing, and performed the searching using the given keywords and retrieve the knowledge pertaining to the keyword. The search approach was evaluated using the Recall and Precision measurements, which shows a high accuracy in retrieving the knowledge of Al-Quran. Furthermore, the ontology classification was evaluated by two experts in Islamic Studies field. This study contributes to the ease of learning and understanding Al-Quran by people of all ages.

**Keywords:** Ontology, Information Retrieval, Semantic Search, Knowledge Management, Al-Quran Knowledge.
Acknowledgement

First and foremost, I would like to thank Allah (S.W.T), for having made everything possible by giving me strength, confidence, and courage to accomplish this project.

I wish to express my sincere gratitude to my supervisor, Dr. Azman Ta'a, for his guidance and direction in this work. He provided me with many interesting, valuable, and sincere feedbacks, throughout his supervision. I greatly benefited from his detailed comments and insights, which helped me clarify the ideas presented in "Ontology-based Approach for Retrieving Knowledge in Al-Quran". I am also grateful to my second supervisor, Assoc. Prof. Dr. Mohd. Syazwan Abdullah. I am thankful to them for their support and motivation.

I wish to express my sincere gratitude and thankfulness to the Al-Quran experts at the Islamic Center, University Utara Malaysia (UUM), Assoc. Prof. Dr. Ismail Ishak, Director of the Islamic Center, and Ustaz Mohd. Yusnaidi Sabri, to help me and giving me of their precious time to evaluate some aspects of the dissertation.

I sincerely thank to my evaluator Dr. Yuhanis Yusof and Dr. Hazaruddin Harun, As well as, Dr. Norliza Katuk for spending time reviewing this research and giving valuable suggestions and comments on my work. I would also like to say a big thanks all University Utara Malaysia (UMM) lecturers and staff at the School of Computing who were kind enough to give me their precious time and assistance, without which I would not have been able to complete this Masters Dissertation. I will always remember it as one of the best phases of my life. I am indebted and thankful to the Chancellor of University Utara Malaysia (UMM), who referred me to valuable e-resources at the Sultanah Bahiyah Library.

I wish to thank the Ministry of Higher Education and Scientific Research of Iraq for the financial support awarded to me, and all the staff and employees of the Technical Institute of Karbala, Iraq.
Last, but not least, words cannot express my gratitude to my family, especially my beloved father, my loving mother, and my brothers and sisters, who always gave me the encouragement to acquire the education which I wanted. Special thanks to my faithful wife, and to my two children, Siraj and Ali. Words cannot describe the importance of their constant love, care, concern, patience, and direction, in every aspect of my life during my the two years of my study abroad. I will be forever thankful, grateful, and indebted to them.

Thank you UUM.
# Table of Contents

Permission to Use ...................................................................................................................... i
Abstrak ....................................................................................................................................... ii
Abstract ...................................................................................................................................... iii
Acknowledgement ..................................................................................................................... iv
Table of Contents ....................................................................................................................... vi
List of Tables ............................................................................................................................. ix
List of Figures ........................................................................................................................... x
List of Appendices ..................................................................................................................... xii
List of Abbreviations .................................................................................................................. xiii

CHAPTER ONE : INTRODUCTION .................................................................................... 1
  1.1 Introduction ...................................................................................................................... 1
  1.2 Background of the Study ............................................................................................... 1
  1.3 Problem Statement ......................................................................................................... 4
  1.4 Research Questions ........................................................................................................ 5
  1.5 Research Objectives ....................................................................................................... 6
  1.6 Scope of the Research .................................................................................................... 6
  1.7 Significant of Research ................................................................................................. 8
  1.8 Summary .......................................................................................................................... 8

CHAPTER TWO : LITERATURE REVIEW ...................................................................... 9
  2.1 Introduction ..................................................................................................................... 9
  2.2 Concept of Ontology ...................................................................................................... 9
  2.3 Query in Ontology-based Retrieval ............................................................................... 11
  2.4 Information Retrieval .................................................................................................... 11
    2.4.1 Knowledge Retrieval ............................................................................................... 11
    2.4.2 Knowledge Representation ..................................................................................... 13
  2.5 Ontology-based Information System ............................................................................ 14
 CHAPTER FIVE :  VALIDATION AND EVALUATION .................. 51
  5.1 Introduction .............................................................................. 51
  5.2 Ontology Validation ................................................................. 51
  5.3 Evaluation .............................................................................. 52
  5.4 Experiment and Finding ......................................................... 54
  5.5 Discussion ............................................................................. 61
  5.6 Summary .............................................................................. 64

 CHAPTER SIX :  CONCLUSION AND FUTURE WORK .................. 65
  6.1 Introduction ............................................................................. 65
  6.2 Conclusion of the Study ......................................................... 65
  6.3 Contribution of the Study ....................................................... 66
  6.4 Recommendations and Future Work .................................... 67

 REFERENCES .................................................................................. 69

 APPENDICES .................................................................................. 75
List of Tables

Table 1.1: The Classifications of Themes.................................................................7
Table 3.1: Questions for Experts' Opinion on the Ontology.................................25
Table 4.1: Al-Quran Ontology in the Database ......................................................39
Table 4.2: Number of Chapter Used in this Research...........................................39
Table 4.3: The Content of the Database......................................................................40
Table 4.4: The Target Keyword that Corresponds to Each sub-theme or sub
sub-theme....................................................................................................................46
Table 5.1: The Test Case for Searching Method..........................................................53
Table 5.2: Details Calculation of Precision and Recall for Theme "Allah".................57
Table 5.3: Details Calculation of Precision and Recall for Theme "Angels"..............58
Table 5.4: Details Calculation of Precision and Recall for Theme "Unseen".............59
List of Figures

Figure 3.1: The General Methodology of Design Research .................................................... 20
Figure 3.2: The Al-Quran Content Hierarchy ........................................................................ 21
Figure 3.3: Measuring Search Effectiveness (Recall and Precision) ........................................ 27
Figure 4.1: Al-Quran Ontology Model .................................................................................. 29
Figure 4.2: The main Interface of the Protégé-OWL ............................................................... 30
Figure 4.3: The Main Classes Hierarchy .................................................................................. 31
Figure 4.4: Class Hierarchy for Al-Quran Ontology (Sub-themes) ......................................... 32
Figure 4.5: Class Hierarchy for Al-Quran Ontology (Sub-sub themes) ................................. 33
Figure 4.6: Object Property Hierarchy .................................................................................. 34
Figure 4.7: Data Property Hierarchy ..................................................................................... 35
Figure 4.8: Individuals Derived from Classes and Properties Hierarchy ............................... 36
Figure 4.9: Annotations Derived from Classes and Properties Hierarchy ............................ 37
Figure 4.10: Results from Annotations Comment After the Classes and Properties have been Defined ........................................................................................................ 38
Figure 4.11: The Data Flow of RDF/OWL Processing ............................................................... 38
Figure 4.12: The Database Design for the New Method .......................................................... 41
Figure 4.13: DDL for Admin Table ......................................................................................... 41
Figure 4.14: DDL for Lookup Table ....................................................................................... 42
Figure 4.15: DDL for RDF/OWL Data table .......................................................................... 42
Figure 4.16: DDL for Surah name Table ................................................................................ 42
Figure 4.17: Exact Matching Flow Chart ............................................................................... 43
Figure 4.18: The Main Interface of the Prototype .................................................................... 45
Figure 4.19: Input Search Criteria Interface .......................................................................... 47
Figure 4.20: The Result of Searching.................................................................48
Figure 4.21: Administrator Login.................................................................49
Figure 4.22: Main Functions for Administrator.................................................49
Figure 5.1 : Precision and Recall for Each Keyword.............................................60
List of Appendices

Appendix 4.1 : The Specification of Al-Quran Ontology.................................75
Appendix 4.2 : The Relationships between Concepts........................................77
Appendix 4.3 : Content of Themes and Sub-themes........................................78
Appendix 4.4 : The Java Code Used for Reading and Processing RDF/OWL File........81
Appendix 4.5 : The Java Code Used for Read Data from Database........................83
Appendix 4.6 : The Java Code Used for Connecting the Database with the Search
              System........................................................................................................86
Appendix 5.1 : The Opinions of Experts on the Ontology Based System for
              Searching and Retrieving Verses in Al-Quran......................................91
Appendix 5.2 : List of Specification / Definition of Ontology Al-Quran...............92
## List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>DDL</td>
<td>Data Definition Language</td>
</tr>
<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
</tr>
<tr>
<td>HTML</td>
<td>Hyper Text Markup Language</td>
</tr>
<tr>
<td>IDE</td>
<td>Integrated Development Environment</td>
</tr>
<tr>
<td>IS</td>
<td>Information System</td>
</tr>
<tr>
<td>JSP</td>
<td>Java Server Pages</td>
</tr>
<tr>
<td>OWL</td>
<td>Ontology Web Language</td>
</tr>
<tr>
<td>RDBMS</td>
<td>Relational Database Management System</td>
</tr>
<tr>
<td>RDF</td>
<td>Resource Description Framework</td>
</tr>
<tr>
<td>SQL</td>
<td>Structured Query Language</td>
</tr>
<tr>
<td>UML</td>
<td>Unified Modeling Language</td>
</tr>
<tr>
<td>URL</td>
<td>Uniform Resource Locator</td>
</tr>
<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
</tr>
</tbody>
</table>
CHAPTER ONE
INTRODUCTION

1.1 Introduction
This chapter provides an overview of this research. It includes a background of the study, which focuses on retrieving knowledge in Al-Quran using the ontology approach. Then, the research problem, research questions and research objectives are discussed. This is followed by the scope and significance of this research, at the end.

1.2 Background of the Study
Islamic scholars have described Al-Quran as the holy book of Muslims that teaches morals, purification, and good deeds. Al-Quran provides guidance to mankind, promotes justice between one another, and provides guidance on how to live on earth with neighbors (Ahmad et al., 2013; Yauri, Kadir, Azman, & Murad, 2012). A related study described Al-Quran as the source of information on any subject matter concerning the world and the hereafter (Shoaib, Nadeem Yasin, Hikmat, Saeed, & Khiyal, 2009). In other words, knowledge gained from Al-Quran cannot be compared with scientific books because the former provides real and deep discussions on matters under examination unlike the latter (Ahmad et al., 2013; Shoaib et al., 2009).

The study of Khan, Saqlain, Shoaib, and Sher (2013) emphasized that searches and retrieval of knowledge in Al-Quran sometimes lacks clarity and accuracy due to the non-implementation of sophisticated and dynamic ways for retrieving knowledge or
The contents of the thesis is for internal user only
REFERENCES


