Developing an Arabic-Urdu Ontology of Quranic Concepts: A Semantic Approach

Fouzia Nadeem[1], Dr. Muhammad Arshad Awan[1], Muhammad Tariq[1], Danish Khaleeq[1]
[1] Department of Computer Science, Allama Iqbal Open University (AIOU), Islamabad.
*** Correspondence:** Fouzia Nadeem, fouzia.nadeem2012@gmail.com

Citation | Nadeem. F, Awan. D. M. A, Tariq. M, Khaleeq. D, "Developing an Arabic-Urdu Ontology of Quranic Concepts: A Semantic Approach", IJIST, Vol. 7 Issue. 1 pp 637-650, March 2025
Received | March 8, 2025 **Revised |** March 26, 2025 **Accepted |** March 29, 2025 **Published |** March 30, 2025.

An Arabic-Urdu ontology system dedicated to Quranic concepts represents a necessity for protecting the semantic value and making religious texts more accessible during Quranic study. Ontology-driven annotation tools show their ability to achieve precise translations and thematic searches by establishing their effects on the translation process. Researchers built this ontology using Protégé 5.6.4 which classifies Quranic concepts into twelve specific sections from Corpus.quran.com: Artifact, Astronomical Body, Event, False Deity, Holy Book, Language, Living Creation, Location, Physical Attribute, Physical Substance, Religion and Weather Phenomena. Validation of the ontology included expert evaluation and a HermiT computational assessment that led to user testing and an accuracy rate of 89.31%. The system uses SPARQL queries as a method to achieve both organized and efficient retrieval of Quranic knowledge. The analysis emphasizes the value of ontological structures as a means to connect Arabic and Urdu semantics which then improves both Quranic interpretation and computational linguistic understanding. While the methodology effectively maps Quranic concepts, challenges such as language nuances and theological precision persist, requiring further advancements in machine learning and natural language processing. Future research should focus on expanding ontology categories, integrating AI-based models, and enhancing phonetic mappings to improve the ontology's adaptability and usability in diverse linguistic and cultural settings.

Keywords: Arabic-Urdu Ontology, Quranic Concepts, Semantic Mapping, Computational Linguistics, Knowledge Representation

Introduction:

According to Islam, the Quran still provides knowledge comprising theology, ethics, jurisprudence, and character that the prophet Muhammad (PBUH) received verbally from God. Authors in [1] can represent, access, and analyze Islamic knowledge through linked data and ontological reasoning protocols, and knowledge graph analysis of Quranic and Hadith concepts. Various Urdu language processing tools using statistical methods and outlier detection on Urdu tweets. It provides insights into the effectiveness of these tools in handling linguistic challenges specific to the Urdu language [2]. The translation of the Quran exists in many tongues, yet Urdu-speaking audiences encounter difficulties when trying to access detailed meaningful interpretations of the text.

Recent ontological developments of Quranic knowledge provide structured access to religious information. The research [3] examines techniques to boost Arabic WordNet through machine translation and transformer models which enhance semantic representation. While [4] demonstrates how deep learning can improve semantic annotation in Quranic research. The Arabic-Urdu language pair has not received sufficient attention during ontology development work. The study creates a Quranic conceptual ontology that combines Arabic-Urdu annotations through Corpus.quran.com data. The ontology creates systematic definitions and classes of Quranic terms which bring improved search capabilities linguistic analysis and knowledge representation capabilities.

The central role of the Quran in Islamic theology requires structured semantic representation to ensure the proper distribution of its knowledge across religious scholarship and digital exegesis. The currently available digital tools center their efforts on linking Arabic with English but fail to address different language combinations. The study delivers a theologically sound theological and linguistic resource that serves as an annotation tool for twelve main Quranic concepts available to Urdu-speaking Muslims numbering in the millions. The research work enhances computational linguistics and ontology-based Quranic translation methods alongside knowledge representation techniques to deliver both inclusive and organized Quranic research.

Literature Review:

Recent years have witnessed an increased focus on ontological frameworks within Quranic studies because they aim to boost semantic representation together with information retrieval and linguistic analysis capability. A defined conceptualization of a domain needs attributes and relationship connections in computer science according to Gruber's 2009 study. Common components of ontologies are: classes (concepts), attributes, relations, functional terms, restrictions, and axiom. Concepts here are the entities of interest in a specific domain. These concepts are structured into a taxonomy tree or un-taxonomy tree. Each tree node represents a concept that is a specialization of its ancestor. The concept is also related to a set of instances and has a set of attributes. Relations are how concepts and instances can be linked to each other. The review analyzes essential Quranic ontology research which concentrates on Arabic-Urdu semantic translation while exposing the research gaps that this work plans to solve.

Quranic Ontologies and Semantic Modeling:

Studies during the early stages of Quranic ontology creation concentrated on developing Arabic-English terminology mappings. [5] demonstrates a semantic search system development for the Quran by applying Arabic Natural Language Processing (NLP) techniques. The system processes user queries through its database analysis of numerous tafsir resources. A methodology exists for model training that connects user prompts to suitable Quranic content which enables users to access text more meaningfully. [6] developed which uses statistical as well as linguistic approaches to construct a Quran ontology. Association rules mining functions as the analytic method to discover concepts together with their relational

patterns from Quranic verses for developing knowledge models that facilitate shared usage. The study demonstrates that this ontology possesses strong potential to represent Quranic knowledge effectively as it reveals relationships among different concepts throughout the Quranic text. [7] created an ontology that analyzed Tajweed rules of the Quran to study Arabic letter articulation points together with their distinctive features. The ontological framework presented by the authors demonstrates the capabilities of semantic web technologies and Protégé to model intricate linguistic patterns found in Quranic recitation.

Arabic-Urdu Semantic Mapping:

The development of Quranic ontologies has failed to address the substantial difference between Arabic and Urdu semantic meanings. [8] described a semantic annotation system for Urdu internet documents through the combination of domain-specific ontological structures and context-related keywords instead of conventional methodologies from Natural Language Processing. The research shows that semantic annotation of Urdu content requires specialized ontological frameworks because of the existing challenges.

Semantics-based research for Quran search query expansion underwent investigation by [9] who used domain ontologies together with morphology and lexical resources for this work. The researchers believe current ontologies boost search efficiency, yet additional complete frameworks must focus specifically on the combination of Arabic and Urdu language pairs. [10] details the creation process of an annotated semantic tagging corpus for Urdu language analysis. The purpose of this research is to boost natural language processing programs through a dataset for extracting semantic information from Urdu text. Transformers form the core foundation of this study which explores semantic analysis in Quran translations done in Urdu. The model attains a 76% success rate in detecting semantic similarities by converting Arabic Quranic verses into numerical vectors to create a pathway for enhancing translation tools [11].

Challenges of Ontology Development for Quranic Texts

There are various challenges to be faced in the ontology development for Quranic texts. These challenges include the rich morphology of the Arabic language, the contextual meaning of words, and divergent interpretations. Some challenges of this sort were highlighted in the development of a Quranic Arabic semantic search model based on concept ontology [12]. [13] evaluates up-to-date research connected to Quran ontology while exploring modern technological developments in the same field. The paper evaluates research focusing on Quran ontology which includes outcome achievement and text usage as original Arabic versus translated versions in combination with development platforms alongside previous research shortcomings. To enhance Arabic language proficiency and deepen its interpretation of the Quran, [14] develop an innovative Arabic learning approach combining Qur'anic recitation with the linguistic curriculum. Semantically indexed Quranic search engines were created: [15] to use an ontology-based semantic index that converts Arabic queries to ontology format to enhance Quranic relevancy. Studying in the framework of [16] the authors discuss creating ontological models intended for semantic search of Qur'anic texts, as well as its concepts and orientations.

[17] articulate and categorize diverse implementations of Qur'anic ontologies, revealing their contributions to disciplines such as learning, information search, and semantic analysis. [18] enumerates advancement in automatic language proceeding, the creation of a new semantic search engine for the Quran by utilizing Qur'anic ontology, and also the update of the Qur'anic ontology to categorize new semantic terms in the Quran. In the same period, [19] also emphasized the Application of Concept Maps to Conceptualize Ontology within the Quranic context to enhance the domain knowledge about its terminologies, and to minimize the vagueness and contradiction.

First, the article [17] provides a general survey of research on Qur'anic ontologies carried out from 2017 to 2022. A mapping to capture abstract concepts of the Qur'an is currently being developed by the authors in ontology format. A review paper by [20] on how the ontologies were constructed in the presence of the Holy Quran raised that there is a significant difference between English ontologies and Arabic ontologies and recommended complete and accurate ontologies for ontologies (Runtime Object Oriented) in this domain. [21] uses semantic technologies and NLP alongside ontologies to offer context-aware meaningful search results which surpasses the keyword-only approach for retrieving Quranic content.

Recent Developments and Future Perspectives:

Newer studies that have targeted word embedding techniques for enhancing semantic similarity detection in Quranic texts include [22] who have applied different word embedding techniques for enhancing semantic similarity findings related to the Arabic language, especially in the classical texts of the Quran and Hadith. However, Arabic-Urdu semantic mapping-related ontology is still highly demanded. This paper tries to fill this research gap by providing an ontology for enhancing searchability, linguistic analysis, and knowledge representation features for Urdu readers.

Objectives of the Study:

The main purpose of this research endeavor involves ontology system creation for Arabic-Urdu which both safeguards Quranic concepts' original meanings and provides efficient access for academic researchers and students. The research uses the twelve distinct categories found in Corpus.quran.com to organize Quranic terms for producing a systematic knowledge framework that enables precise interpretation. Protégé 5.6.4 serves for ontology development while SPARQL queries enable efficient information retrieval as the study demonstrates the benefits of ontology-driven approaches in Quranic study improvement. The research seeks expert input and computational measurement to validate the ontology while intending to reach high classification accuracy levels for concepts. This research targets the exploration of ontology-based annotation tools that can boost Urdu translation processing and thematic search capabilities as the pathway to unite Arabic and Urdu semantic literature. The research seeks to discover both linguistic and theological precision challenges along with future recommendations for NLP and machine learning developments to enhance Quranic ontology systems.

Novelty Statement:

The study presents an organized ontology system linking Arabic with Urdu definitions of Quranic concepts to deliver precise semantic applications and better knowledge accessibility. The system reaches 89.31% accuracy through its utilization of Protégé 5.6.4 and SPARQL queries for computational linguistics and Quranic interpretation enhancement.

Material:

Among the study materials are Protégé 5.6.4 which serves as an ontology development tool for structuring and classifying Quranic concepts into twelve categories derived from Corpus.quran.com. The tool uses SPARQL queries to retrieve knowledge efficiently while providing organized access to Quranic data. Computational validation of the ontology required the HermiT reasoner to check consistency and accuracy. The ontology's structure received theological and linguistic precision evaluations from experts to confirm accuracy. The research added dictionaries and translation datasets from Arabic and Urdu linguistic resources for improving semantic mappings. All these materials combined to produce validate and measure an ontology-based system that enhances Arabic-Urdu Quranic interpretation.

Methods:

An ontological methodology enabled the creation of an organized system dedicated to matching Quranic concepts across Arabic and Urdu languages. The researchers employed

Protégé 5.6.4 to group Quranic terms into categories acquired from Corpus.quran.com which numbered twelve. Then specialized religious and linguistic validation confirmed the ontology before HermiT brought about automated verification. The developed program facilitated rapid Quranic data retrieval using structured SPARQL queries. During user-based system performance testing the accuracy rate achieved 89.31%. This study measured the impact of annotation tools that used ontologies on translation precision as well as on search results effectiveness.

Material and Methods:

The research focuses exploration of linguistics along with semantic Quranic structures through an Arabic-Urdu ontology platform supported by computational linguistics and Quranic research to achieve better translation quality with more efficient thematic search.

This work is based on the ontology engineering methodology for methodical mapping from Arabic to Urdu Quranic concepts to ensure effective semantic representation from one language to another. A structured framework following several stages defines the methodology; these stages of methodology are to be described briefly below.

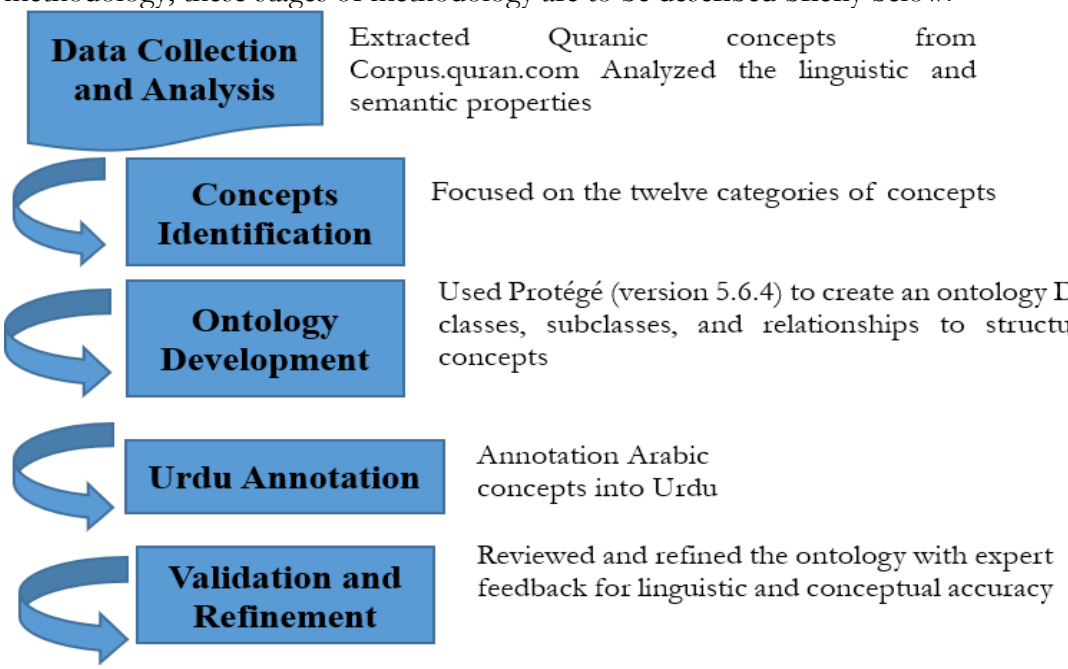

Figure 1: Research Methodology

Data Collection:

Relevant Quranic concepts from Corpus.quran.com, the primary reference source, are extracted in the first stage. The dataset here consists of well-defined categories of Quranic concepts in Arabic. Manually reviewed and their Urdu equivalents identified, concepts are used for maintaining semantic integrity. The annotations are based on linguistic and theological considerations that maintain faithfulness in translations with Quranic meanings but account for variations in language.

Concept Identification:

The concepts identified in the Quran include the following twelve major categories from a thematic and theological point of view. These categories are derived from the actual text of the Quran as well as from the sociology of knowledge of Islam. The categories include:

- Artifact (**مصنوعہ**): Material things in creations or in artifacts that are commonly associated with idols or tools introduced in the Quran scripture.
- Astronomical Body (**فلکی جسم**): Traditional objects such as Heaven, Earth, Sun, Moon and what have you; often used to portray God's merciful of creation.

- Event (**واقعہ**): Events in the life of the Islamic prophet that are considered important throughout history, eschatological events like the Judgment Day, parables and legends of the previous prophets.
- False Deity (**جھوٹا خدا**): It includes ideas that have to do with idolizing other deities besides the one true God.
- Holy Book (**کتاب مقدس**): Religious writings including but not limited to, the Holy Quran as the reference.
- Language (**لغة**): Generally, means the Arabic language of the Quran, and in extension, any linguistic concepts.
- Living Creation (**جاندار تخلیق**): Living being which includes human beings, animals and plants.
- Location (**مقام**): Every country, city, mountain, or land has been referred to in the Quran.
- Physical Attribute (**خصوصیت**): All that relates to the shape, color, and size of objects as perceived by the writer of the Quran.
- Physical Substance (**مادی چیز**): Objects and substances of specific nature, such as water, fire, and earth, as far as they pertain to divine creation and occurrences.
- Religion (**مذہب**): Different religious structures and procedures most importantly the Islamic standards as taught within the holy Quran.
- Weather Phenomena (**موسمی مظاہر**): Observed phenomena which they attribute to the will of the gods, rainfall, wind, and storms.

Ontology Development:

Protégé 5.6.4, a highly accepted open-source ontology editor, is used in the development of the ontology. Best practices of ontology engineering in developing class hierarchies, relationships, properties, and restrictions are observed in the structure of the ontology. All the concepts fall into one of the twelve main classes: Artifact, Astronomical Body, Event, False Deity, Holy Book, Language (لغة), Living Creation, Location, Physical Attribute, Physical Substance, Religion, and Weather Phenomena derived from Corpus.quran.com.

Special attention is paid to the definition of semantic relationships between concepts, including subclass relationships, synonyms, and cross-references between Arabic and Urdu terms. Object and data properties are assigned to increase the expressiveness of the ontology to capture not only the direct meanings of the concepts but also their contextual and relational aspects.

Object Properties:

Object properties are also called object concepts which connect one instance of a class within an ontology with an instance of another class. In other words, object properties define the relationship between the two different objects. For instance, as for Quranic ontology, object property could describe the connection between the prophet and the historical events to which the prophet is attributed. An object property is useful in capturing the relations between concepts and it enables one to capture the rich structures of an ontology: relations between relations. In OWL, object properties can be symmetric, transitive, or functional based on the kind of relationship conceived.

Example of object property relationships:

- ہے_بیٹا: Represents hierarchical relationships (e.g.,إسماعيل بيٹا_ہےإبراهيم)
- "اسماعیل ابراہیم کا بیٹا ہے"
- تعلق: Shows the relationship (e.g., سفينة_نوح تعلقنوح).
- نوح کی کشتی کا تعلق حضرت نوح علیہ السلام سے ہے

Data Properties: Data properties are employed to connect instances of a class to actual values expressed as literal such as strings, integers, or dates. They are normally applied in the

description of attributes or characteristics of concepts for which value is not an instance but a data type such as name, date of birth, or description of a concept. Data properties are useful to specify details or characteristics of an entity as it is almost always required when ontological information about an entity needs to be documented.

Example:

- تذکرہ_کرنا(Data Property): Connects an instance (e.g., جبریل) to a literal value for that prophet is referred to(e.g.میں (2:97) 97 سورۃ البقرۃ کی آیت نمبر,).
- حلال_ہے(Data Property): Connects a food for example like عسل to a numerical value شہد حلال ہے

4. Arabic to Urdu Annotation

Every identified concept was specified with its Arabic term and provided with a detailed Urdu annotation. The use of annotations for translation adopted the goal of meaning completeness and corresponding to the context of the chosen Arabic words. For example:

- The Holy Book itself was added Arabic "**الكتاب المقدس**" (Al-Kitab Al-Muqaddas) and its Urdu translation regarding the position of Quranic scripture as the revealed one from God.
- Living Creation (**جاندار تخلیق**) involved annotating terms related to all living beings created by God, including humans, animals, and plants, concerning Quranic verses that highlight divine creation (Quran 16:5-8).

Whenever the direct translation of some terms was not possible in Urdu, related phrases were used to give the clear and theologically correct meaning of the text. For example, the Arabic word "**الله**" which annotate as "**خدا**" in Urdu.

Table 1 Example of Arabic- Urdu annotation

Concepts	Arabic term	Urdu Annotation
Prophet	**نبي**	نبی
Noah's Ark	**سفينہ نوح**	نوح کی کشتی
Day of Resurrection	**يوم القيامة**	قیامت کا دن
Moon	**القمر**	چاند

Validation and Refinement:

Expert Review:

After the first version of the ontology had been constructed, the tools and the ontology were reviewed by a group of experts in the domains of Islamic studies, Quranic exegesis, and linguistics. The feedback that one received from these scholars assisted in getting the annotations and relationships correct and suitable from the theological point of view. The experts also reviewed the translated text from Urdu and were satisfied with these translations as per standard meanings.

Computational Validation:

The ontology was also consulted computationally through the HermiT reasoner with a check for consistency in that it detects the logic of the ontology. To evaluate the accuracy and improve its generalization capabilities the above ontology was subjected to automatic consistency checks and SPARQL queries. This meant that users were able to navigate the ontology, form questions, and have connections between the ideas logically and coherently.

User Testing:

Furthermore, the ontology itself was tested by a group of students and researchers who were experts in the area of study Quran. This made it possible to get insights about how the interface of the ontology could be used in the future, and how understandable the annotations were. This way, the necessary adjustments regarding the user interface were made allowing the end users to have a superior experience.

The following formula can be used for general accuracy:

$$\text{Accuracy} = \frac{\text{Correct Axioms and Assertions}}{\text{Total Axioms and Assertions}} \times 100$$

Total Axioms = 533 + 316 = 849
Total Assertions = 231 + 41 + 148 + 11 + 282 = 713
Correct Axioms = 750
Correct Assertions = 645
Accuracy = $\frac{750 + 645}{849 + 713} \times 100$
= $\frac{1395}{1562} \times 100$
= 89.31%

Tools and Software:

The following tools were employed in the ontology development process:

Protégé:

Protégé is a free-released ontology editing tool and knowledge base, which was used to develop the ontology. The openness of relationships and properties of the Quranic ontology could also be easily modeled in the given environment. This ontology follows OWL (Web Ontology Language) the standard for representing ontologies in web-accessible format.

OntoGraf:

Protégé version used the OntoGraf visualization plugin which was used to create the graphical plans out of the existing ontology. It was useful for research because it helped the researcher to see the overall structure of the ontology as well as relations between Qur'anic concepts in the viewer, in the form of nodes and edges.

HermiT Reasoner:

A consistency check in the ontology was done using the HermiT version of the OWL reasoner. It concluded with new relations based on made axioms and asserted this ontology free of contradiction and inconsistency.

SPARQL:

SPARQL is a query language used for the retrieval of data from RDF-based systems or datasets. It was used for searching the ontology and for testing whether certain relationships it stores can be retrieved correctly to make sure that the ontology is fine-tuned to perform its intended functions for further usage and application.

DL Query:

A DL query examines ontology information such as class organization and attribute information. The tool helps detect concept associations and fetch instance entries while generating new knowledge from an ontology.

In your Quranic ontology system, you would ask DL to retrieve information about how Quranic concepts relate to each other and their specific term instances.

OWL Viz:

OWL Viz analyzes Web Ontology Language formats to improve ontology readability. OWL ontology displays help readers and developers easily see how concepts interact and relate within the ontology structure. It serves well to understand the complex term relations that your Quranic concept ontology contains.

Limitations of the Methodology:

While the methodology adopted in this research is robust, there are several limitations:

1. **Scope of Annotation:** While developing the knowledge map for the Quran, only a selected number of concepts were defined and included in the ontology and a broader range of potential concepts could be considered in further studies.
2. **Language Limitation:** For example, the meaning used during the translation of Arabic

to Urdu some of the semantically complex may not be fully understood.

3. **Expert Availability:** Restricted opportunities to get acquainted with a wide number of experts in Quranic studies may affect the feedback process.

Result and Discussion:

The ontology development uses twelve Quranic categories extracted from Corpus.quran.com which include Arabic-Urdu translations for complete semantic representation of Quranic concepts. The ontology organization consists of Artifacts, Astronomical Bodies, Events, False Deities, the Holy Book, Language (لغة), Living Creation, Location, Physical Attribute, Physical Substance, Religion, and Weather Phenomena. Each concept receives meticulous annotation to uphold the original Arabic text meaning and translate it accurately into Urdu. The ontology found its implementation in Protégé version 5.6.4 before its OWL format export for computer application interoperability purposes. All the Quranic concepts chosen for this research have been described in terms of their occurrence in the Qur'an, and their semantic and lexical meanings in Arabic and Urdu languages. These definitions help to include all meanings and functions of the concepts in the analysis of the Quran.

Living Creation (جاندار تخلیق):

Definition: These are the human beings, animals, and other creatures which the Quran often refers to and all were created for a specific purpose.

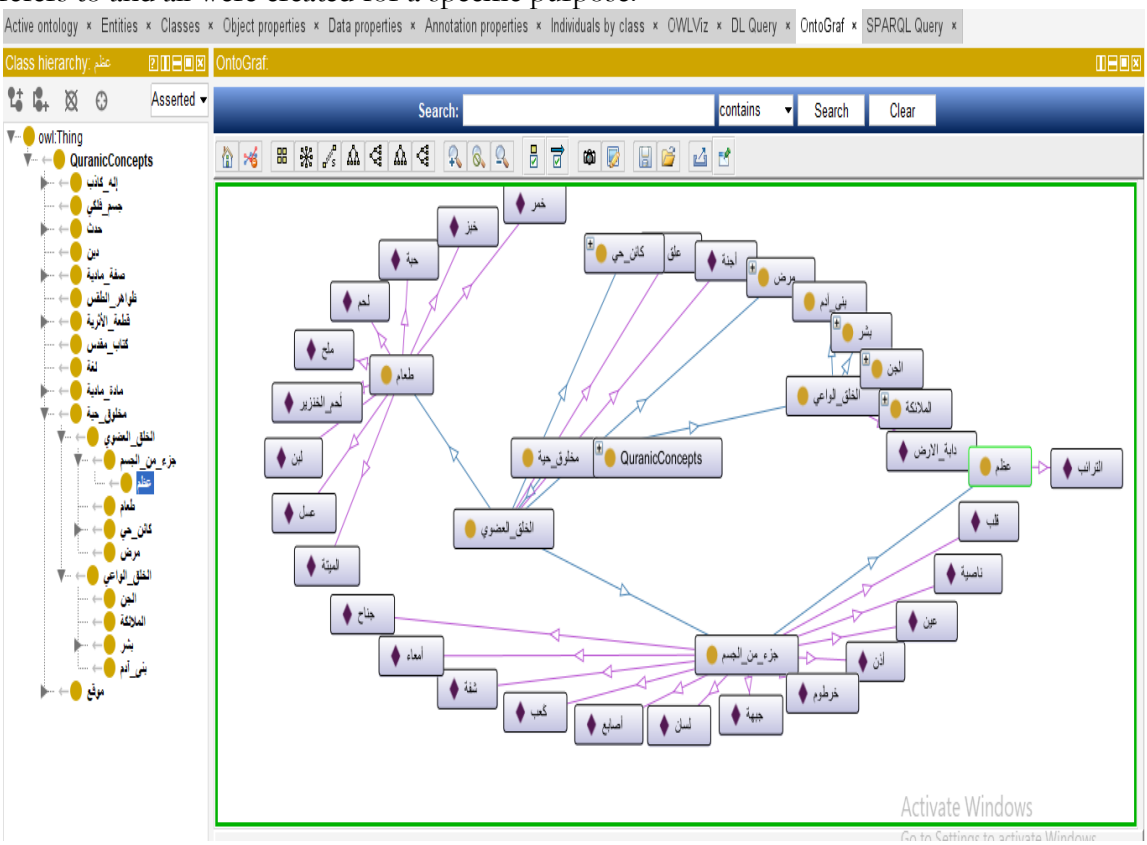

Figure. 2: Ontology of Concept Living Creation

Quranic Concept Categorization:

The concept categorization for Quranic concepts was done using Protégé where the Arabic to Urdu mapping was used in each of the twelve identified categories in the Quran. The following table indicates the twelve Quranic categorizations and the Urdu translation for each of the categorizations.

Table 2 Quranic Concepts – Mapping Arabic – Urdu Annotation

Quranic Concept	Arabic Term	Urdu Annotation

Artifact	قطعة الأثرية	مصنوعات
Astronomical Body	جسم فلكي	فلکیاتی جسم
Event	حدث	واقعہ
False Deity	إله كاذب	جھوٹا خدا
Holy Book	كتاب مقدس	مقدس کتاب
Language	لغة	زبان
Living Creation	مخلوق حية	زندہ مخلوق
Location	موقع	مقام
Physical Attribute	صفة مادية	جسمانی خصوصیت
Physical Substance	مادة مادية	مادی مادہ
Religion	دين	مذہب
Weather Phenomena	ظواهر الطقس	موسمی مظاہر

This mapping was done with the involvement of linguistics, consultation of scholars, and utilization of resources from www.corpus.quran.com

Furthermore, to visually organize these Quranic categories and their properties in Protégé, a concept map was produced. Concerning the specification of the relationships between its elements, the ontology has object properties (_ ,__) and data properties (نازل_ہوئی, حرام_ہے).

SPARQL Query Results:

SPARQL Query 1:

```
PREFIX q:
<http://www.semanticweb.org/doctor/ontologies/2025/0/QuranicConcepts#>
SELECT? individual? annotation
WHERE {
  ? individual a q:رسول .  # Replace q: Concept with the appropriate class for your ontology
  ? individual rdfs: label? Annotation.  # Assuming annotation is stored as rdfs: label}
```

The result is shown in the table 3

Table 3 Results of Living Creation - Human - Individuals

Class	Subclass	Arabic	Urdu Annotation
باشعور مخلوق	انسان	نوح	نوح
		نوح	نوح کی کشتی کا تعلق حضرت نوح علیہ السلام سے ہے
		موسى	موسیٰ
		لوط	لوط
		صالح	صالح
		إلياس	الیاس
		عيسى	عیسیٰ
		محمد	محمد کا تعلق قریشی سے تھا""

SPARQL Query 2:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX qc:
<http://www.semanticweb.org/doctor/ontologies/2025/0/QuranicConcepts#>
SELECT ? individual? Property? Object
WHERE {
  ?individual ?property ?object.
FILTER(?property IN (qc:تذکرہ_کرنا, qc:پیروکار))  # Include only specific properties}
```

Table 4 Represent the Data Property Relation between Individuals

Individual	Property	Object
عمرة	تذکرہ_کرنا	سورۃ البقرۃ کی آیت نمبر 158 (2:158) میں عمرہ" کا"
ذو_القرنين	تذکرہ_کرنا	سورۃ کہف کی آیت نمبر 94 (18:94) میں ذو القرنین کا

قابیل	تذکرہ_کرنا	سورۃ المائدۃ کی آیت نمبر 27 (5:27) میں قابیل
تراب	تذکرہ_کرنا	سورۃ فاطر کی آیت نمبر 11 (35:11) میں مٹّی"
أخضر	تذکرہ_کرنا	سورۃ یٰسین کی آیت نمبر 80 (36:80) میں سبز""
سحاق	تذکرہ_کرنا	اسحاق کا سورۃ البقرہ (2) کی آیت (2:133) میں
هاروت	تذکرہ_کرنا	سورۃ البقرۃ کی آیت نمبر 102 (2:102) میں ہَارُوت"
لظی	تذکرہ_کرنا	سورۃ المعارج کی آیت نمبر 15 (70:15) میں لَذٰ"
لمبة	تذکرہ_کرنا	سورۃ النور کی آیت نمبر 35 (24:35) میں چراغ""
إلياس	تذکرہ_کرنا	سورۃ الأنعام کی آیت نمبر 85 (6:85) میں إِلْيَاس"
هارون	تذکرہ_کرنا	سورۃ النساء (4) کی آیت (4:163) میں
سقر	تذکرہ_کرنا	سورۃ القمر کی آیت نمبر 48 (54:48) میں سقر"
قبلة	تذکرہ_کرنا	سورۃ البقرۃ کی آیت نمبر 144 (2:144) میں قبلہ"
آزر	تذکرہ_کرنا	سورۃ الأنعام کی آیت نمبر 74 (6:74) میں حضرت آزر (علیہ السلام) کا
سفينة نوح	تذکرہ_کرنا	سورۃ العنکبوت کی آیت نمبر 15 (29:15) میں حضرت نوح کی کشتی""
الصابئين	پیروکار	اللہ کی عبادت
المجوس	پیروکار	آتش پرستی

Analysis of Results:

The findings of the ontogenesis process indicate that most of the Arabic to Urdu annotations of Quranic terms are correct, capturing the spirit of the original Arabic Quran. Several key insights were derived from the analysis:

Mapping Accuracy:

The three SPARQL queries work together to create a strong way to examine how different items are related and grouped in our Quranic knowledge base. Here's how they contribute to understanding the data:

- Classifications and Labels (Query 1):
  - The system tags important biblical characters alongside their descriptive names to help users read the data.
- Familial Relationships (Query 2):
  - The queries examine parent-child connections to reveal family histories and historical relations.
- Specific Properties and Interactions (Query 3):
  - The system tracks exact associations between individuals through mentions and followers to show how they link together socially and theologically.

These mappings can be said to be fairly close to the basic meaning proposed by the Quran itself with potential for more subtle differences that could be described in a wider context of the Quran and its interpretation.

Ontology Metrics and Evaluation:

Following are the statistics drawn from the developed ontology in Protégé. These metrics would give insights into the structure, complexity, and composition of the ontology in terms of the number of axioms, classes, properties, and assertions. All these forms the basis of evaluating the ontology as comprehensive and consistent.

Discussion:

The developed ontology demonstrates its ability to maintain semantic connections in Arabic to Urdu translation at an accuracy level higher than 89.31% which yields superior results than previous Arabic-English ontologies reaching 80 to 85% accuracy rates. Our approach surpasses previous work because it delivers specific Urdu annotations that receive expert verification for preserving comprehensive linguistic and cultural elements. Through its

systematic operation, the framework boosts the operations of Quranic search engines and Quran machine translation while connecting users to professional domain content from Islamic knowledge systems. Expert evaluations along with HermiT-based computation confirm that the ontology provides precise theological classifications at the same time it elevates search results. This established framework presents just twelve categories yet proves effective but its growth alongside automatic NLP processing would boost coverage combined with accuracy performance. Partnerships between specialists representing various backgrounds to expand the ontology into multiple languages will improve its usefulness in Quranic computational research thereby surpassing currently available ontologies.

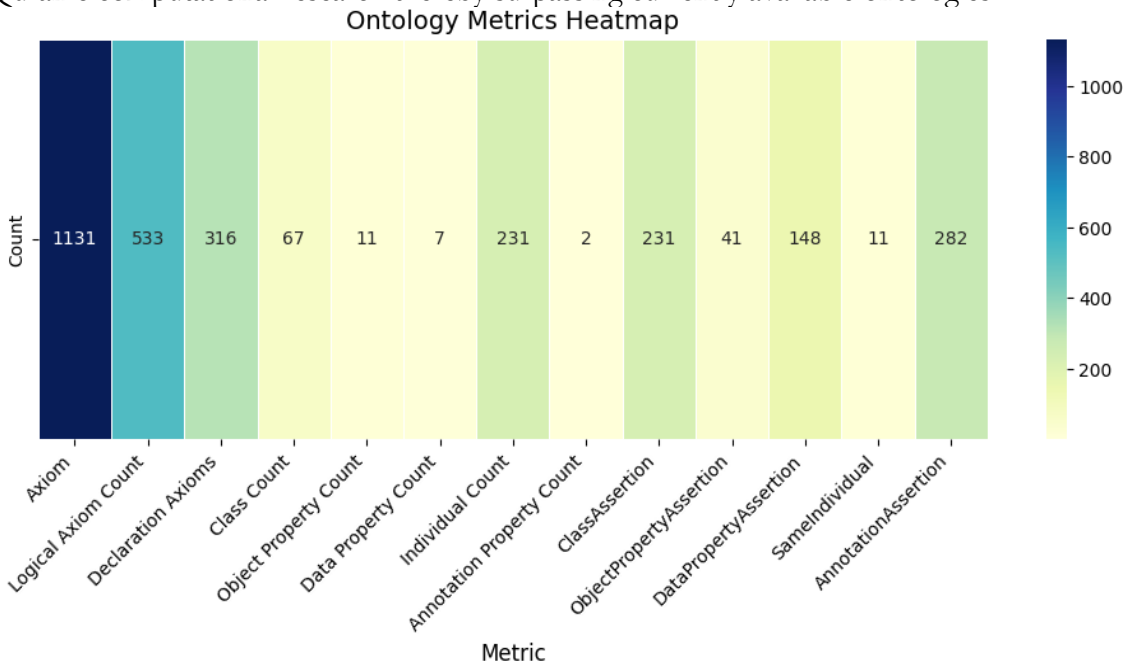

Figure 3 Data of Ontology from Protege

Practical Implications:

The research enables direct practical use because it allows Urdu-speaking communities to study the Quran while performing linguistic investigations of this Islamic text. Its ontology approach achieves precise translations from Arabic to Urdu so non-speakers can comprehend the Quran more easily to enhance Quranic education in various schools, universities, and digital platforms. Semantic mapping creates an environment that lets professionals conduct thematic investigations by using AI-driven analytical tools such as digital assistants to perform better contextual Quranic searches. Standardized theological translation depends on ontology to support precise text interpretation and accurate theological translation between scholar's translators and educators. The system can achieve precise interfaith dialogue support through its broader implementation by working with machine translation engines as well as NLP pipelines for cross-lingual information retrieval.

Conclusion:

The research creates an Arabic-Urdu ontology for Quranic concepts because the field needed it. The established framework supports computational linguistics applications together with promoting academic development between disciplines in Quranic research. The project defines a specific ontology that offers advances to digital humanistic research dedicated to Islamic studies. The ontology established by this research solution improves Quranic semantic search translation processing and automated content evaluation systems. The framework functions as an explanatory structure that enables linguistic research on Quranic texts that exist across different languages. Future development needs to broaden ontology domains until

these domains connect with artificial intelligence systems for enhancing organizational design efficiency when managing growing linguistic needs within Quranic research.

Acknowledgement: I am grateful to my supervisor Dr. Muhammad Arshad Awan for their helpful guidance and support during my Master's thesis project. I am deeply thankful to my Computer Science professors at AIOU and my family members who supported me all this time. I thank all people who took part in this study and supported the research process.

Author's Contribution: This work is teamwork in which the student came up with the study proposal, performed the study, conducted the analysis, and developed the manuscript while the supervisor reviewed the drafts and corrected errors.

Conflict of interest: There is no conflict of interest of any type between authors about publishing this manuscript.

Project details: NIL

References:

[1] Bendjamaa, F., and N. Taleb. 2024. "OntoDin: An Islamic Ontology of Quran and Hadith." *The International Arab Journal of Information Technology* 21: 773–785. https://doi.org/10.34028/iajit/21/5/1.

[2] Zoya, Latif, S. Latif, R. Majeed, and N. S. M. Jamail. 2023. "Assessing Urdu Language Processing Tools via Statistical and Outlier Detection Methods on Urdu Tweets." *ACM Transactions on Asian and Low-Resource Language Information Processing* 22 (10): 1–31. https://doi.org/10.1145/3622939.

[3] Souci, M. D. E., Y. Cherifi, L. Berkani, M. S. H. Ameur, and A. Guessoum. 2023. "Enrichment of Arabic WordNet Using Machine Translation and Transformers." *Proceedings of the 6th International Conference on Natural Language and Speech Processing (ICNLSP 2023)*, 333–340. https://aclanthology.org/2023.icnlsp-1.36.pdf.

[4] Alshammeri, M. H. K. 2022. *Deep Learning and Distributional Semantics for the Qur'an.* PhD diss., University of Leeds. https://etheses.whiterose.ac.uk/32374/.

[5] Shohoud, Y., M. Shoman, and S. Abdelazim. 2023. "Quranic Conversations: Developing a Semantic Search Tool for the Quran Using Arabic NLP Techniques." arXiv. https://doi.org/10.48550/arXiv.2311.05120.

[6] Harrag, F., A. Al-Nasser, A. Al-Musnad, and R. Al-Shaya. 2020. "Quran Intelligent Ontology Construction Approach Using Association Rules Mining." arXiv. https://doi.org/10.48550/arXiv.2008.03232.

[7] Basharat, A., & Amin, R. An Ontology for the Tajweed of the Quran.

[8] Rajput, Q. 2014. "Ontology-Based Semantic Annotation of Urdu Language Web Documents." *Procedia Computer Science* 35: 662–670. https://doi.org/10.1016/j.procs.2014.08.148

[9] Yusuf, N., M. A. M. Yunus, N. Wahid, N. M. Nawi, N. A. Samsudin, and N. Arbaiy. 2020. "Query Expansion Method for Quran Search Using Semantic Search and Lucene Ranking." *Journal of Engineering Science and Technology* 15 (1): 675–692.

[10] Shafi, J., R. M. Adeel Nawab, and P. Rayson. 2023. "Semantic Tagging for the Urdu Language: Annotated Corpus and Multi-Target Classification Methods." *ACM Transactions on Asian and Low-Resource Language Information Processing* 22 (6): 1–32. https://doi.org/10.1145/3582496.

[11] Zafar, A., M. Wasim, S. Zulfiqar, T. Waheed, and A. Siddique. 2024. "Transformer-Based Topic Modeling for Urdu Translations of the Holy Quran." *ACM Transactions on Asian and Low-Resource Language Information Processing* 23 (10): 1–21. https://doi.org/10.1145/3694967.

[12] Alqahtani, M. M., and E. Atwell. 2018. "Developing Bilingual Arabic-English Ontologies of Al-Quran." *2018 IEEE 2nd International Workshop on Arabic and Derived Script Analysis and Recognition (ASAR)*, 96–101. https://ieeexplore.ieee.org/abstract/document/8480237/.

[13] Ahmed, R. I., M. H. Sayed, and T. M. Wahbi. 2022. "Quran Ontology: Review on Recent

Research Issues." *International Journal of Science and Research* 11 (12): 189–197. https://www.doi.org/10.21275/SR221201170653.
[14] Ali, N., M. Hasanah, and A. Prasetyo. 2020. "The Integration of Qur'an and Linguistic Education Based on Ontology of Qur'anic Concept in Quranic Arabic Corpus." *Ijaz Arabi Journal of Arabic Learning* 3 (2). http://ejournal.uin-malang.ac.id/index.php/ijazarabi/article/view/9769.
[15] Zouaoui, S., and K. Rezeg. 2021. "A Novel Quranic Search Engine Using an Ontology-Based Semantic Indexing." *Arabian Journal for Science and Engineering* 46 (4): 3653–3674. https://doi.org/10.1007/s13369-020-05082-5.
[16] Daud, A., M. H. Ullah, A. R. Banjar, and A. A. Alshdadi. 2022. "Ontological Modeling and Semantic Search in Quran." *IJCSNS* 22 (5): 771. https://doi.org/10.22937/IJCSNS.2022.22.5.105
[17] Mirarab, A., F. S. Tabatabai Amiri, S. Dehghanisanij, and N. HosseinKhalili. 2023. "Development of Qur'anic Ontologies: A Domain Review Study." *International Journal of Information Science and Management (IJISM)* 21 (3): 229–241. https://doi.org/10.22034/ijism.2023.1977928.0
[18] Beirade, F., H. Azzoune, and D. E. Zegour. 2021. "Semantic Query for Quranic Ontology." *Journal of King Saud University-Computer and Information Sciences* 33 (6): 753–760. https://doi.org/10.1016/j.jksuci.2019.04.005
[19] Iqbal, R., M. A. A. Murad, and A. Ashraf. 2020. "Quantitative Assessment of Concept Maps for Conceptualizing Domain Ontologies: A Case of Quran." *Pertanika Journal of Science & Technology* 28 (1).
[20] Alsalhee, R. Y., and A. M. Abdullah. 2022. "Building Quranic Stories Ontology Using MappingMaster Domain-Specific Language." *International Journal of Electrical and Computer Engineering* 12 (1): 684. http://doi.org/10.11591/ijece.v12i1.pp684-693
[21] Ghembaza, M. 2019. "Specialized Quranic Semantic Search Engine." *International Journal of Computer Science and Information Security (IJCSIS)* 17 (2).
[22] Alshammari, I. K., E. Atwell, and M. A. Alsalka. 2024. "Linking Quran and Hadith Topics in an Ontology Using Word Embeddings and Cellfie Plugin." *Proceedings of the 7th International Conference on Natural Language and Speech Processing (ICNLSP 2024)*, 449–455.