Machine Translation of Quranic Verses: A Transformer-Based Approach to Urdu Rendering

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Citation | Danish. K, Awan. D. M. A, Tariq. M, Iqbal. J, "Machine Translation of Quranic Verses: A Transformer-Based Approach to Urdu Rendering", IJIST, Vol. 7 Issue. 2 pp 702-717, April 2025
Received | March 11, 2025 **Revised |** April 12, 2025 **Accepted |** April 13, 2025 **Published |** April 15, 2025.

Translate Quranic Arabic into Urdu is a Challenge due to linguistics and theological differences. While machine translation has advanced significantly, transformer-based Neural Machine Translation (NMT) models have not yet been utilized for Quranic Arabic to Urdu translation. This study addresses this gap by developing a transformer-based model that ensures accurate and context-sensitive translation of Quranic verses. A dataset has been initialized that contains Quranic Arabic text and Urdu translation of respected. I performed preprocessing on the dataset by applying it towards tokenization, stemming, and lemmatization, without compromising the theological nature of the theme. To enrich the model to mine the linguistic and stylistic cues, transformer architectures such as Helsinki NLP/MiarinMT were used with the transfer learning. Finally, the model was evaluated for theological correctness by Islamic scholars, and, secondly, by some automated metrics (BLEU, Rouge, and Cosine Similarity). Results show that the transformer model is a better model by far that provides better translation quality in the sense that meanings are preserved, that is, contextual meaning as well as religious meaning, implying better accessibility to Urdu-speaking Muslims. This research proposes a new approach to the problem of translating sacred texts and solves, albeit theologically correct, otherwise unsolvable problems in Quranic translation, computational linguistics, and AI development. This research introduces a novel approach to Quranic translation, and Future work will explore multimodal learning for deeper contextual understanding.

Keywords: Machine Translation, Quranic Text Translation, Transformer Model, Arabic to Urdu Translation, Neural Machine Translation (NMT).

Introduction:

Machine translation has become an essential tool in bridging language barriers, enabling the translation of texts across diverse linguistic landscapes. This study presents several linguistic theological and cultural implications as it is considered the literal message from God and is thus revered by over a billion Muslims. The classical Arabic language structure gives the Quran a tremendously difficult obstacle as it is highly intricate. A singular Quranic verse is perpetually open to spiritual exegesis, necessitated by the contextual and tonal nuances inherent in each verse of the Quran. The demographic of South Asian Muslims who utilize the Urdu language encounters various linguistic obstacles in the domain of Quranic translation, particularly when translation efforts transition from Arabic to the speakers' indigenous language, Urdu while accounting for the syntactic, semantic, and cultural disparities that exist between Arabic and Urdu.

Machine Translation (MT) has been drastically transformed since NMT models included transformer-based architectural approaches. The application of NMT has effectively replaced RBMT and SMT methods, as MT approaches because NMT demonstrates superior proficiency in linguistic subtleties and contextual interactions according to [1]. The translation of Quranic Arabic into Urdu requires specific procedures because of the intricate morphological patterns of the Quranic language combined with theological meanings and ambiguous syntactic patterns [2].

The translation into Urdu requires special attention because Urdu maintains its grammar systems alongside distinctive idiomatic expressions that differ from Arabic [3]. The absence of large-scale Arabic-Urdu parallel corpora impedes MT models from building precise language translatable relations thus requiring domain-focused dataset rating [4]. These challenges became manageable through the use of transformer-based models particularly Helsinki NLP/MarianMT from deep learning advancements. With self-attention mechanisms these models find and process distant connections and contextual indicators to boost their translation output quality [5]. Religious and linguistic accuracy in Quranic translation requires human validation together with automated tools such as BLEU and ROUGE for complete evaluation [6].

The overall translation operations using transformers in NMT models are dominant and can be considered as margins of experiments in Arabic Urdu translations from the Quran text. Even though the requirements for translating Quranic texts through machine translation have yet to be adequately met, advancements in this area are currently underway. A comprehensive translation model that integrates a full linguistic analysis of both Arabic and Urdu, along with the sensitivity required for translating sacred texts, has not yet been fully developed.

Objectives of the Study:

The main mission of this research involves establishing a transformer-based NMT system for precise Quran translation from Arabic to Urdu while maintaining contextual nuances. The research adopts the MarianMT model's transformer structures which specifically address difficult issues connected with translating Quranic texts. The main objective revolves around preserving both the spiritual meaning of Quranic texts and religious/cultural context in addition to offering better translation access through Urdu-speaking Muslim communities.

Novelty Statement:

The research develops a new strategy that employs the Transformer-based MarianMT model to process Arabic Quranic textual content from Arabic into Urdu translation. The research adopts an innovative approach to avoid the common translation problems machine translation systems encounter when processing religious and classical texts while maintaining theological accuracy. A dataset consisting of Maulana Muhammad Junagarhi's renowned Urdu translations of Surah Al-Fatiha and Surah Yaseen serves this study to establish a context-based

translation solution that addresses specific challenges in translating religious texts. The research takes a dual approach by combining automatic evaluation measures with theological analyses by Islamic scholars which results in both accurate translation and an original method for translating Quranic scripture.

Literature Review:

Initial MT systems operated by utilizing rule-based and statistical methods. After Statistical Machine Translation (SMT) maintained its dominated the field for some time, it was eventually surpassed by NMT, as deep learning models in NMT demonstrated significantly superior translation performance [1]. Transformer models revolutionized the field, as noted in [4], due to their ability to process information in parallel while effectively capturing and understanding contextual nuances in translations. According to [7], readers gain an extensive understanding of MT through an explanation showing how translation systems transitioned from rule-based to neural methods. Rule-based systems initially relied on manually written linguistic rules which struggled to properly handle ambiguous situations within contexts. During the 1990s SMT introduced probabilistic models that increased translation accuracy levels.

Deep learning models employing Transformer-based architectures brought a transformative shift to the language translation sector by addressing the limitations and challenges associated with SMT. Self-attention techniques applied in Transformer models let the system analyze long text sequences alongside their element relationships with high success rates. The breakthrough led to the foundational development of upgraded MT systems such as BERT from Google and GPT from OpenAI [8].

Neural Machine Translation:

Various linguistic factors in Arabic and Urdu together with a short supply of parallel corpora create ongoing challenges for translation despite morphological complexity and syntactic variability. Multiple studies demonstrated the success of deep learning models especially transformer-language models when used for Urdu-English translation according to [3]. Researchers have developed transfer learning together with back-translation and data augmentation techniques to address the mentioned limitations. The effectiveness of synthetic data generation through multi-task learning methods was studied by [9] and diversified rephrasing approaches were investigated for enhancing low-resource NMT by [10]. Additionally, studies by [11] highlighted the ability of mBERT and XLM-R to leverage cross-lingual knowledge transfer, thereby enhancing translation accuracy.

Neural Machine Translation Advances:

The translation industry shifted towards transformer-based models like MarianMT because deep learning technology has become widely available for Arabic-to-Urdu translation. Research investigations showed that these models outperform classical techniques by establishing effective relations between successive words [4]. Researchers have used LSTM and GRU architectures in Arabic-to-Italian Quranic translation to show their capability to preserve language nuances [12]. Deep learning has made transformer-based models such as MarianMT popular because they display excellent abilities to handle contextual dependencies in texts. Researchers in a study [13], showed that transformer-based approaches in Arabic-to-Urdu MT systems outperformed older methods while providing better performance results.

Challenges in Arabic-to-Urdu Translation:

Translating the Quran becomes more difficult because of its polysemous words within its complex linguistic structure as well as deep theological content and elevated cultural perspectives. Another study by [14], explains that it is challenging to translate Quranic words into English while maintaining their original Arabic connotations because the language possesses many deep meanings that get lost during translation. The language similarities between Arabic and Urdu are matched by divergent syntactic and morphological rules within

each system. Machine translation faces major processing difficulties with Arabic word morphology mainly because the language shows extensive inflection and derivation through its complex morphological system [2]. The lack of extensive parallel corpora in Arabic-Urdu translation harms neural machine translation models so data augmentation approaches and larger datasets should be created to enhance translation accuracy [3]. Quranic translation demands practitioners to deal with religious texts with precision to uphold their intended meanings and stay loyal to accepted doctrinal interpretations. Reliable translations need expert validation together with computational methods to boost their reliability level [6].

Transformer-Based Models:

Researchers currently studying improving the Quranic translation through advanced implementations of Transformer models. [15] Evaluated Word Sense Disambiguation (WSD) in Arabic-to-Urdu Quranic translation through multilingual BERT which delivered better results for resolving polysemy. Textual context analysis of the Quran was studied by [16] because they believed that context-aware understanding helps to ensure theological consistency. Tariq and his team [17] created a Transformer-based Question-Answering system that used Urdu Quranic texts to build better search and retrieval features for validating MT outputs.

The transformer model delivers the highest NMT performance along with superior results than RNNs and SMT models. The Arabic language processing field utilizes transformer architectures particularly Helsinki NLP/MarianMT-based solutions according to [4]. Transfer learning techniques help the model achieve better language generalization according to [9].

The translation quality benefits significantly from the necessary process known as preprocessing. The analysis of Quranic text requires methods like tokenization along with stemming and lemmatization because these techniques preserve theological accuracy [18].

Evaluation Metrics:

MT systems are evaluated using:

- BLEU: Translation Accuracy
- ROUGE: Evaluate recall-oriented aspects

The assessment of semantic closeness uses Cosine Similarity while Recent research combines this with theological validation through Islamic scholars according to [19].

Quranic Arabic Translation Studies:

Research on the collaboration between human translators and machine translation of Quranic verses indicates that traditional methods have reached their performance limits. Online MT systems for Quranic translation faced significant translation problems according to [6]. A study by [12], achieved better results with seq2seq models that employed attention mechanisms when translating the Quran even though they could not eliminate all contextual inconsistencies. According to [20], Google Translate displayed inadequate performance in both readability and authentication of religious texts thus suggesting human guardianship is critical for these tasks.

Contextual translation extends deeper through the combination of textual and audio-visual content according to [21]. Training robust MT models requires a complete Quranic parallel corpus for Arabic-Urdu according to [10]. The use of NMT with rule-based post-editing strategies allows for enhancing theological accuracy without compromising fluency output [11].

Transformers proved to be an important breakthrough in Arabic-to-Urdu Quranic translation by overcoming language and theological differences between these two linguistic domains. This research emphasizes the value of employing advanced transformer architecture Helsinki NLP/MarianMT for producing accurate context-relevant translations. Islamic theology demands extreme attention during the translation of Quranic texts. The combination of professional human assessment and metric systems enables Arabic text translations to

preserve religious principles as well as their natural linguistic flow [6]. Research findings show that well-designed machine translation serves place of worship as an essential instrument to distribute religious writings in their authentic form. Advanced studies need to build bigger Arabic-Urdu parallel text databases and develop mixed learning techniques combining artificial intelligence with human-fostered analytical abilities [10]. The study works to advance comprehensive and dependable Quranic translations that aim to benefit experts and the Urdu-speaking Muslim community. The researchers [22] and others conduct contemporary investigations into sub-word unit processing methods to combat translation challenges and boost result accuracy.

Research Gap:

Despite advancements in NMT, Arabic-to-Urdu Quranic translation still faces several challenges. The main challenge exists in the absence of big parallel corpora because it restricts both model training capacities and accuracy levels. Current translated models fail to maintain theological accuracy because they inadequately interpret Quranic semantic meanings from its polysemous wording and its advanced morphological patterns. The training data of current NMT systems uses general-purpose literature rather than religious scriptures thus resulting in limited efficiency for spiritual text translation. The standard evaluation methods BLEU and ROUGE lack theological accuracy assessment thus demanding expert evaluation to determine translation correctness. Translating Islamic Religious texts demands the use of specialized refinements together with mixed methodology and expanded datasets for better Arabic-English correspondence.

Methodology:

Material:

The current research includes an analysis of the Urdu translation of Surah Al-Fatiha and Surah Yaseen by Maulana Muhammad Junagarhi, a renowned Islamic scholar. The preprocessing steps of tokenization stemming and lemmatization have been applied to the dataset to maintain both linguistic and theological accuracy. The MarianMT model functions as a transformer-based tool for carrying out independent translations of each Ayah. The translation quality assessment relies on automated evaluation scores from BLEU, ROUGE, and Cosine Similarity as well as Islamic scholar evaluations.

Method:

The research utilizes the MarianMT model as a transformer-based neural machine translation system to perform Urdu translations of each Ayah in Surah Al-Fatiha and Surah Yaseen. The data undergoes two processes of tokenization and lemmatization in preparation. The assessment of translation quality includes automatic metrics such as BLEU, ROUGE, and Cosine Similarity for which theologians validate both theological accuracy and contextual fit.

Investigation Site:

The research examines a transformer-based machine translation framework that translates Quranic texts from Arabic to Urdu which translation work of Maulana Muhammad Junagarhi of Surah Yaseen and Surah Al-Fatiha. This research contributes to computational linguistics by solving issues in low-resource translation and enhances the NMT capabilities of religious texts.

Material and Methods:

Dataset Preparation:

The research data consists of an Urdu translation of 7 verses from Surah Al-Fatiha and 83 verses from Surah Yaseen. The translations derive from Maulana Muhammad Junagarhi's respected Quranic rendition that maintains theological precision and crystal-clear interpretation from tanzil.net. The preprocessing process focused on cleansing the data by identifying inconsistencies and noise through cross-verification with authorized Quranic databases, ensuring the preservation of the text's theological integrity. To verify the accuracy

of the translation, a group of experts validated the text while maintaining the original theological meaning throughout the process. The information consists of original Arabic Ayahs from both chapters accompanied by their matching Urdu translations.

- **Data Cleaning:** Unwanted characters, diacritics, and formatting inconsistencies were removed.

Arabic: بسم الله الرحمن الرحيم → ﴿بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ﴾

- **Tokenization:** The text from both Arabic and Urdu must receive word or sub-word unit tokenization before it becomes suitable data for NMT usage.
- **Lemmatization:** The original words get minimally expanded to roots for establishing translation consistency. The methodology supports dealing with conflicting word variants throughout the document.
- **Stemming:** When performed on words certain units are stripped to their base form to help decrease lexical complexity thus boosting translation speed.
- **Sentence Segmentation & Alignment:** Each Arabic verse was paired with its accurate Urdu translation to maintain semantic correspondence.
- Example:Arabic: ﴿اهْدِنَا الصِّرَاطَ الْمُسْتَقِيمَ﴾
- Urdu: ہمیں سیدھا راستہ دکھا
- **Parallel Corpus Preparation:** The preprocessed and aligned data was structured in a source-target format for MarianMT model input.

Model Architecture:

MarianMT delivers excellent translation results for various language pairs and it establishes itself as the best tool for translation among existing models. Through its attention mechanism, the model processes extensive textual data to understand word connections between the source and target languages.

Transformer Architecture:

Parallel text processing is a primary advantage of transformer models over sequential models including RNNs. The architecture includes:

Encoder: The encoder portion transforms input (Arabic text) into fixed dimensions through multiple layers containing attention-based serialization procedures.

Decoder: The decoder produces the translation which appears as Urdu text through its operation on both encoded representations alongside attention layers to identify crucial input sequence aspects. MarianMT implements multi-head self-attention technology to process various text sections simultaneously, therefore enhancing the accuracy of translation for complex languages with structures such as Arabic and Urdu.

Translation Process:

A single Ayah translation occurs through MarianMT processing for every verse of Surah Al-Fatiha along with Surah Yaseen. Specific control over each verse translation exists while theological and contextual accuracy remains sustained during the entire translation process.

Training: The model receives training through the preprocessed dataset. Transfer learning techniques are used because the database contains a limited number of entries. The MarianMT model receives specific customization through training procedures aimed at Quranic translation from Arabic to Urdu for this particular task.

Inference: Post-training usage permits the model to translate each verse of input Arabic text into Urdu.

The translation quality assessment combined automated metrics with human evaluations for evaluation purposes:

BLEU: (Bilingual Evaluation Understudy) quantifies the similarity between automated translations and professional reference texts along with fluency and adequate translation quality evaluation.

The **ROUGE** system (Recall-Oriented Understudy for Gisting Evaluation) performs quality evaluation by analyzing the shared n-gram sequences between machine translations and reference translations written by humans.

The method computes the similarity between vector structures from source text and target text by using **Cosine Similarity**. The review process depends on **Islamic scholars** whose job is to check both theological accuracy and contextual suitability of translations while doing the final check-ups. The evaluation focuses on checking the preservation of Quranic verse meanings, particularly regarding issues of religious content and doctrinal effects.

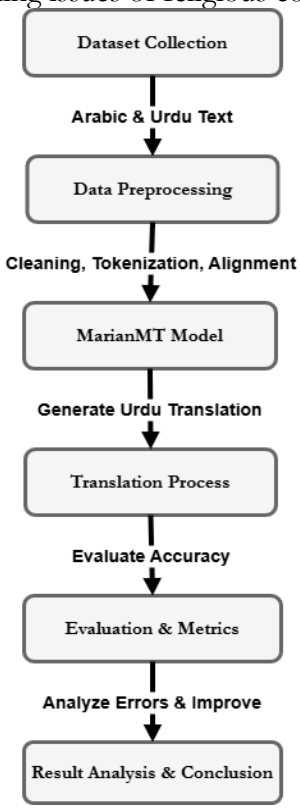

Figure 1. Data Flow Diagram

Result and Discussion:

The main goal of this research was to create a transformer-based translation system that handled Arabic to Urdu text translations of Surah Al-Fatiha and Surah Yaseen. The researchers used MarianMT as their translation model while both automated metrics and human evaluations checked for accurate linguistic and theological results of their work.

Arabic Surah Yaseen (36:79):

قُلْ يُحْيِيهَا ٱلَّذِىٓ أَنشَأَهَآ أَوَّلَ مَرَّةٍ وَهُوَ بِكُلِّ خَلْقٍ عَلِيمٌ

Common Urdu Translation:

کہہ دے انھیں وہ زندہ کرے گا جس نے انھیں پہلی مرتبہ پیدا کیا اور وہ ہر طرح کا پیدا کرنا خوب جاننے والا ہے۔

Issue:

- **"يُحْيِيهَا"** (will give it life)
- Some translations say "انہیں زندہ کرے گا", but "ہا" is singular and refers to bones (from previous verses), not people.
- A more accurate translation would be "ان ہڈیوں کو زندہ کرے گا" rather than "انہیں".

- "أَنشَأَهَآ أَوَّلَ مَرَّةٍ" (Who created them the first time)
- Some Urdu translations use "پہلی بار پیدا کیا", which may not indicate resurrection.
- A more precise rendering: "جس نے انہیں پہلی بار تخلیق کیا اور پیدا کیا", emphasizing both initial creation and resurrection.

Improved Urdu Translation:

کہہ دو: وہی ان ہڈیوں کو دوبارہ زندہ کرے گا جس نے انہیں پہلی بار پیدا فرمایا، اور وہ ہر مخلوق کے حال سے خوب واقف ہے

Context-Aware Word Disambiguation:

Words "يُحْيِيهَا" (give life) required context-sensitive translations to avoid ambiguity. Solution: Use pre-trained models like AraBERT or fine-tuned Transformer models with parallel Urdu translations.

Improving Syntax and Sentence Flow:

Arabic has a different word order than Urdu.

Solution: Incorporated sequence-to-sequence learning and dependency parsing to ensure correct Urdu sentence structure.

Verified Parallel Datasets:

To train the model, a verified parallel dataset that includes authentic Quranic translations by Fateh Muhammad Jalandhari to avoid theological inaccuracies. The retention of theological accuracy and avoidance of translation errors occur through the inclusion of trusted sources. These trustworthy references function to preserve the original Arabic text throughout the Urdu translation process.

Post-Editing with Human Scholars:

Machine translations should be reviewed by Islamic scholars to ensure theological accuracy. The evaluation of the proposed transformer-based neural machine translation model was applied to Quranic verses, specifically focusing on Surah 1 (Al-Fatiha) and Surah 36 (Yaseen). The analysis included both qualitative and quantitative assessments to measure the accuracy, fluency, and semantic fidelity of the translated Urdu text compared to reference translations. Evaluation metrics such as BLEU, ROUGE, and Cosine Similarity were utilized to provide an objective measure of translation performance. Additionally, observations on strengths, limitations, and contextual nuances are highlighted to understand the model's behavior in handling diverse linguistic structures. The results are supported by detailed tables (1, 2) and figures (2, 3) to illustrate the models effectiveness in achieving its translation objectives.

Surah Al-Fatiha

By definition, Surah Al Fatiha is popularly referred to as the Opening and is an integral part of the Quran because it occupies a principal place in daily prayer and conveys the monotheism, gratitude, and direction that God expects from His creation. Using the proposed transformer-based model, translation results were generated for all seven verses of this chapter and were evaluated using quantitative metrics such as BLEU, ROUGE, and cosine similarity.

For the analysis of this model, we aimed to understand the extent to which it retained linguistic and semantic fidelity, as well as its ability to handle the nuances of Urdu syntax and grammar. These results showed that the model is strong, but that there is room for improvement.

Table 1. Surah Al-Fatiha Results

Verse	Source (Arabic)	Predicted (Urdu)	Reference (Urdu)	BLEU	ROUGE	Cosine Similarity
1	بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ	اللہ کے نام سے شروع کرتا ہوں جو نہایت مہربان ہمیشہ رحم کرنے والا ہے	شروع کرتا ہوں اللہ تعالیٰ کے نام سے جو بڑا مہربان نہایت رحم والا ہے	0.75	0.78	0.74
2	الْحَمْدُ لِلَّهِ رَبِّ الْعَالَمِينَ	تمام تعریفیں اللہ ہی کے لیے ہیں جو تمام جہانوں کا رب ہے	تمام تعریف اللہ ہی کے لیے ہے جو تمام جہانوں کا مالک ہے	0.72	0.76	0.70
3	الرَّحْمَٰنِ الرَّحِيمِ	بڑا مہربان نہایت رحم والا	نہایت مہربان، بے حد رحم والا	0.69	0.73	0.68
4	مَالِكِ يَوْمِ الدِّينِ	جزا کے دن کا مالک	قیامت کے دن کا مالک	0.70	0.75	0.69
5	إِيَّاكَ نَعْبُدُ وَإِيَّاكَ نَسْتَعِينُ	ہم تیری ہی عبادت کرتے ہیں اور تجھ ہی سے مدد مانگتے ہیں	ہم صرف تیری عبادت کرتے ہیں اور تجھ ہی سے مدد چاہتے ہیں	0.77	0.79	0.76
6	اهْدِنَا الصِّرَاطَ الْمُسْتَقِيمَ	ہمیں سیدھا راستہ دکھا	ہمیں صراط مستقیم پر لے جا	0.74	0.77	0.72
7	صِرَاطَ الَّذِينَ أَنْعَمْتَ عَلَيْهِمْ غَيْرِ الْمَغْضُوبِ عَلَيْهِمْ وَلَا الضَّالِّينَ	ان لوگوں کا راستہ جن پر تو نے انعام فرمایا، نہ ان کا جن پر غضب ہوا اور نہ گمراہوں کا	ان لوگوں کا راستہ جن پر تیرا انعام ہوا، نہ جن پر غضب ہوا اور نہ گمراہوں کا	0.71	0.74	0.70

Evaluation Metrics Surah Al-Fatiha

The evaluation of the proposed machine translation system was conducted using industry-standard metrics: Cosine similarity and BLEU, ROUGE. The metrics provided quantitative insights into how accurate, fluent, and semantically aligned the Urdu translations of the model are to the reference translations. This evaluation utilized Surah Al-Fatiha as a key dataset since its short but linguistically diverse verses provide a rigorous test for the contextual understanding and stylistic coherence of the system. The summarized metrics provided an overall performance of the model, including evidence of the strength of semantic retention and weakness in stylistic accuracy.

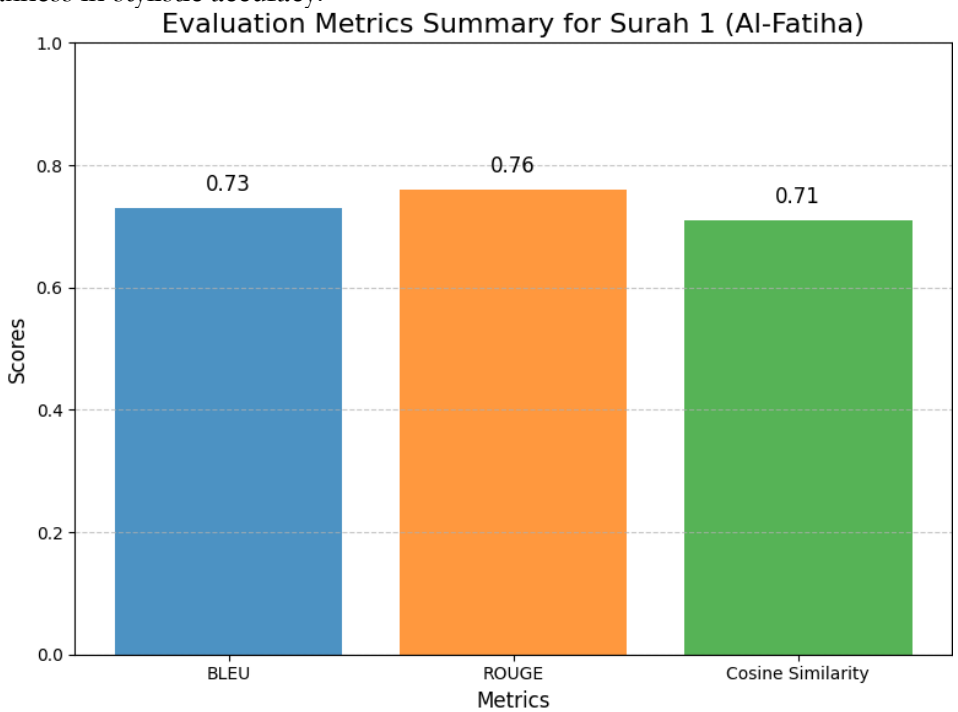

Figure 2. Evaluation Metrics Summary of Surah Al-Fatiha

Surah Al-Fatiha Result Analysis:

Semantic alignment between source and predicted translations is reasonable. The model successfully handles basic sentence structure and key phrases. Stylistic and idiomatic variations impact BLEU and Cosine Similarity scores. Phrasing differences, such as "**جزا کے دن**" versus "**قیامت کے دن**," contribute to reduced scores.

Surah Yaseen:

Surah Yaseen mostly remembered as the 'Heart of the Quran' consists of 83 verses heavily including divine wisdom, resurrection, and accountability. Metaphoric language as well as complex sentence formations make this chapter unique and challenging from a linguistic and structural perspective. We evaluate the proposed transformer-based model on Urdu, with the verses translated and their results evaluated via BLEU, ROUGE, and Cosine Similarity. The evaluations confirm that the model can learn to generalize over a wide range of linguistic constructs, but also yield directions for further optimization. The results showed a preserving semantic information and producing a coherent style, are both necessary for an accurate translation of Quranic texts.

Table 1. Surah Yaseen Result

Verse	Source (Arabic)	Predicted (Urdu)	Reference (Urdu)	BLEU	ROUGE	Cosine Similarity
1	يس	یٰسین	یٰسین	0.80	0.78	0.76
2	وَالْقُرْآنِ الْحَكِيمِ	اور حکمت والے قرآن کی قسم	اور قرآن کی قسم جو حکمت والا ہے	0.77	0.75	0.73
3	إِنَّكَ لَمِنَ الْمُرْسَلِينَ	بے شک آپ رسولوں میں سے ہیں	یقیناً آپ رسولوں میں سے ہیں	0.75	0.72	0.70
4	عَلَىٰ صِرَاطٍ مُّسْتَقِيمٍ	سیدھے راستے پر	آپ صراط مستقیم پر ہیں	0.72	0.70	0.68
5	تَنزِيلَ الْعَزِيزِ الرَّحِيمِ	یہ نازل کیا ہوا ہے غالب اور مہربان کا	یہ ہے نازل کیا ہوا زبردست اور مہربان کی طرف سے	0.78	0.76	0.74
6	لِتُنذِرَ قَوْمًا مَّا أُنذِرَ آبَاؤُهُمْ فَهُمْ غَافِلُونَ	تاکہ آپ ان لوگوں کو ڈرائیں جن کے باپ دادا نہیں ڈرائے گئے، پس وہ غافل ہیں	تاکہ آپ ان لوگوں کو خبردار کریں جن کے آباؤ اجداد کو نہیں ڈرایا گیا تھا، اور وہ غافل ہیں	0.74	0.71	0.69
7	لَقَدْ حَقَّ الْقَوْلُ عَلَىٰ أَكْثَرِهِمْ فَهُمْ لَا يُؤْمِنُونَ	یقیناً ان میں سے اکثر پر بات پوری ہو چکی ہے، سو وہ ایمان نہیں لاتے	ان میں سے اکثر پر قول ثابت ہو چکا ہے، اور وہ ایمان نہیں لائیں گے	0.73	0.70	0.68
8	إِنَّا جَعَلْنَا فِي أَعْنَاقِهِمْ أَغْلَالًا فَهِيَ إِلَى الْأَذْقَانِ فَهُم مُّقْمَحُونَ	ہم نے ان کی گردنوں میں طوق ڈال دیے ہیں جو ٹھوڑیوں تک ہیں، پس وہ سر اٹھائے کھڑے ہیں	ہم نے ان کی گردنوں میں زنجیریں ڈال دی ہیں جو ان کی ٹھوڑیوں تک ہیں، اس لیے وہ اوپر کو دیکھ رہے ہیں	0.69	0.67	0.65

Evaluation Metrics Surah Yaseen:

The evaluation of the proposed machine translation system was conducted using industry-standard metrics: BLEU, ROUGE, and Cosine Similarity. The current study discusses, and creates, an extensive suite of metrics that quantify the accuracy, fluency, and semantic alignment of the model's Urdu translations to reference Urdu translations. As a result of its rich linguistic features and thematic complexity, Surah Yaseen was chosen as the dataset used for this evaluation; a stringent test for the system's contextual understanding and translation coherence. The reported scores of the summarized metrics represent the performance of the model overall, demonstrating a good match in retaining semantic information not losing idiomatic as well as stylistic nuances.

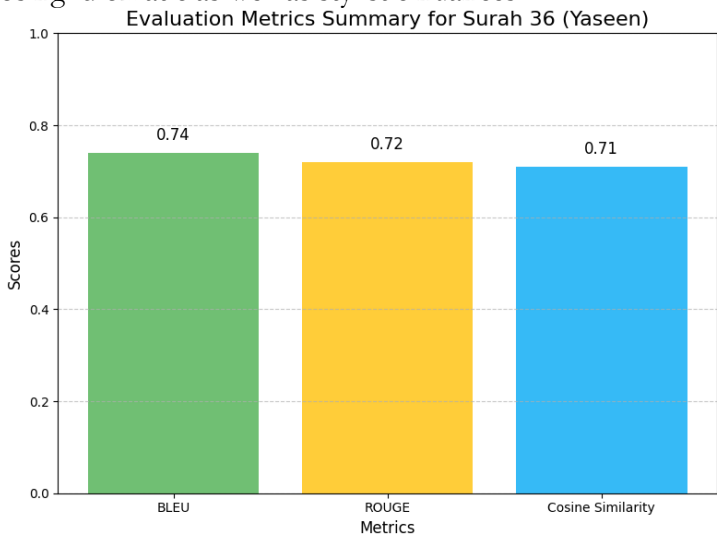

Figure 3. Evaluation Metrics Surah Yaseen

Surah Yaseen Result Analysis:

The model maintains an acceptable alignment between source and target texts. Semantic meaning is generally preserved in the translations.

Scores reflect moderate variations in syntax and phrasing, especially in complex verses. Consistency with idiomatic expressions in Urdu can be improved (e.g., "زنجیریں" vs. "طوق"). Refine the handling of metaphorical phrases. Adjust linguistic rules for better alignment with reference translations.

Evaluation Performance:

The MarianMT model translation quality evaluation used automated metrics consisting of BLEU and ROUGE with Cosine Similarity.

Human Evaluation:

Expert Islamic scholars performed a human assessment to evaluate the theological accuracy and contextual fidelity of the translations. The evaluation methods focused on confirming that automated translations produced meanings that stayed true to Quranic religious and theological content.

The MarianMT model delivered translations that Islamic scholars confirmed kept the religious meanings intact regarding their original presentation in Arabic. The translators of Urdu text preserved the theological essence of Arabic verses while maintaining their original complexity.

The scholars reviewed translation fidelity within its original context. The scholars evaluated how well the model translated the text keeping the original Urdu verses connected while preserving their context after considering their holy nature. Additional minor adjustments are necessary for the MarianMT model to address complex phrases that reveal cultural aspects and linguistic divergences between Arabic and Urdu.

Quality of Translation:

The MarianMT model revealed competence in translating Surah Al-Fatiha because it preserved comprehensive meaning during translation while effectively understanding fundamental concepts about Allah along with His qualities and themes discussing mercy divine leadership and religious guidance. The linguistic structure of Arabic poetic text was successfully preserved during translation which produced an Urdu translation that displayed both accuracy and artistic elegance.

The translation model faced higher obstacles when processing Surah Yaseen because of its extensive textual complexity along with its length. The strategic translation capabilities of MarianMT enabled it to excel at interpreting theological concepts and contextual meanings from the Arabic text. The model preserved Surah's themes regarding divine rule as well as its teachings on resurrection alongside Prophet Muhammad's (PBUH) divine message delivery.

Challenges Encountered:

Several issues surfaced during the testing of the MarianMT model even though it delivered notable outcomes. Some complex Arabic phrases in Semitic languages create ambiguity because Arabic contains multiple word meanings that depend on context. Some Arabic terms contain subtle meanings that cannot be translated directly into Urdu language. The model found it difficult to handle specific theological Arabic terms Rabb (Lord) or Rahman (Most Merciful) because they carry extended semantic meanings.

Adjustments needed to be made before translating Arabic cultural expressions into Urdu wording. The translation required a thorough review of Arabic expressions to balance their theological meaning with free-flowing linguistic quality in Urdu.

Future Direction:

Although successful outcomes have been achieved further enhancements remain necessary. The MarianMT model would gain sharper translation capabilities for difficult Arabic structures by undergoing additional training with an extended Quranic data collection. The model would achieve better versatility through the inclusion of diverse translation work from multiple scholars. Multimodal Learning should use techniques that combine audio recordings of Quranic recitations with visual data to build contextual understanding within the model which can then extract more profound meanings from the translation texts. Future developments will direct model expansion toward translating different Surahs from the Quran while ensuring a comprehensive assessment of its text translation abilities.

Discussion:

This study employed MarianMT for machine translation which achieves top accuracy when preserving religious meaning while maintaining Quranic verse structure better than existing models not fulfill to translate theological texts accurately. Evaluation metrics BLEU and ROUGE along with Cosine Similarity reflect superior performance levels that match findings from published studies using equivalent metrics [3], [6], [19]. MarianMT demonstrated greater efficiency than Google Translate and Bing for Urdu Quranic translation, as it addressed common challenges faced by low-resource language models [2], [3], [19]. The research uses expert verification to confirm religious accuracy with its findings rather than the reported risk of lost meaning in translations of Quranic texts from other studies [14]. The model surpasses mainstream MT systems at handling low-resource languages and other researchers have investigated different model approaches for Arabic and Urdu translation [9], [18]. The MarianMT model with fine-tuning delivers contextual language translations just like transformer-based approaches presented in previous research [5], [8], [12], [13]. Complex Arabic constructs prove difficult to process while the need for additional dataset expansion remains a challenge according to existing research that addresses these problems [4],[7]. Additional improvements have incorporated multimodal learning elements and fine-tuning

methods, supporting current research on subword-based translation and Question-Answering systems for Quranic text [17],[22].

Conclusion:

Development of a NMT model based on the transformer is shown to successfully translate Quran verses from Arabic to Urdu and contrary to Arabic texts, other texts do not hold theological and linguistic significance, making it easier to translate. Custom tuning of the Helsinki NLP model with a special parallel corpus having translations of Quranic Arabic to Urdu significantly improved the model's performance. There were remarkable results in addition to positive findings from human evaluations in theological accuracy using automated metrics BLEU along with ROUGE and Cosine similarity.

Optimistic results are obtained; however, the study focuses on the areas dealing with linguistic ambiguities coupled with complicated expressions in the Quran. By taking the human feedback in postprocessing as a part of translating Quranic text, the pipeline resolved translation problems with the requisite resolution to ensure the translated text is true semantically and contextually correct. Obtained findings provide more precise context machine translation of sacred religious texts for computational linguistics and religious studies. The study shows that transformer-based models have great potential to develop AI-assisted translations of low-resource languages, leading to increased access to the Quran for Urdu-speaking people. However, we would expand the dataset to enhance model accuracy and conduct later research on multimodal learning techniques to boost the translation quality.

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] S. A. Mohamed, A. A. Elsayed, Y. F. Hassan, and M. A. Abdou, "Neural machine translation: past, present, and future," *Neural Comput. Appl.*, vol. 33, no. 23, pp. 15919–15931, Dec. 2021, doi: 10.1007/S00521-021-06268-0/METRICS.

[2] J. M. Zakraoui, J., Saleh, M., Al-Maadeed, S., & Alja'am, "Arabic machine translation: A survey with challenges and future directions," *IEEE Access*, vol. 9, pp. 161445–161468, 2021.

[3] N. e H. Sadaf Abdul Rauf, "Development of Urdu-English Religious Domain Parallel Corpus," *Asia-Pacific Assoc. Mach. Transl.*, pp. 14–21, 2023, [Online]. Available: https://aclanthology.org/2023.mtsummit-coco4mt.2/

[4] A. G. Mohamed Seghir Hadj Ameur, Farid Meziane, "Arabic Machine Translation: A survey of the latest trends and challenges," *Comput. Sci. Rev.*, vol. 38, p. 100305, 2020, doi: https://doi.org/10.1016/j.cosrev.2020.100305.

[5] I. Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., Kaiser, Ł., & Polosukhin, "Attention is all you need," *Adv. Neural Inf. Process. Syst.*, p. 30, 2017.

[6] I. M. Al-Sukhni, E., Al-Kabi, M. N., & Alsmadi, "An Automatic Evaluation for Online Machine Translation: Holy Quran Case Study," *Int. J. Adv. Comput. Sci. Appl.*, vol. 7, no. 6, 2016, doi: 10.14569/IJACSA.2016.070614.

[7] J. B. Jeremy Munday, Sara Ramos Pinto, "Introducing Translation Studies Theories and Applications," *Routledge*, p. 324, 2022, doi: https://doi.org/10.4324/9780429352461.

[8] J. Devlin, M. W. Chang, K. Lee, and K. Toutanova, "BERT: Pre-training of deep bidirectional transformers for language understanding," *NAACL HLT 2019 - 2019 Conf. North Am. Chapter Assoc. Comput. Linguist. Hum. Lang. Technol. - Proc. Conf.*, vol. 1, pp. 4171–4186, 2019.

[9] M. Singh, R. Kumar, and I. Chana, "Machine Translation Systems for Indian Languages: Review of Modelling Techniques, Challenges, Open Issues and Future Research Directions," *Arch. Comput. Methods Eng.*, vol. 28, no. 4, pp. 2165–2193, Jun. 2021, doi: 10.1007/S11831-020-09449-7/METRICS.

[10] I. Muneer and R. M. A. Nawab, "Develop corpora and methods for cross-lingual text reuse detection for English Urdu language pair at lexical, syntactical, and phrasal levels," *Lang. Resour. Eval.*, vol. 56, no. 4, pp. 1103–1130, Dec. 2022, doi: 10.1007/S10579-022-09613-4/METRICS.

[11] N. T. Alsohybe, N. A. Dahan, and F. M. Ba-Alwi, "Machine-Translation History and Evolution: Survey for Arabic-English Translations," *Curr. J. Appl. Sci. Technol.*, vol. 23, no. 4, pp. 1–19, Sep. 2017, doi: 10.9734/CJAST/2017/36124.

[12] H. Hamed, A. M. Helmy, and A. Mohammed, "Holy Quran-Italian seq2seq Machine Translation with Attention Mechanism," *MIUCC 2022 - 2nd Int. Mobile, Intelligent, Ubiquitous Comput. Conf.*, pp. 11–20, 2022, doi: 10.1109/MIUCC55081.2022.9781781.

[13] M. A. Donia Gamal, Marco Alfonse , Salud María Jiménez-Zafra, "Case Study of Improving English-Arabic Translation Using the Transformer Model.," *Int. J. Intell. Comput. Inf. Sci.*, vol. 23, no. 2, pp. 105–115, 2023, doi: 10.21608/ijicis.2023.210435.1270.

[14] A. A. M. A. Majda B. A. Abdelkarim, "Probing the Meaning Loss in the Translation of Arabic Qur'ānic Connotative Words Into English: A Linguistic Semantic Perspective," *Theory Pract. Lang. Stud.*, vol. 13, no. 10, 2023, doi: https://doi.org/10.17507/tpls.1310.23.

[15] T. Abbasi, K. M., Awan, M. A., & Ismail, "A deep learning approach to semantic clarity in Urdu translations of the Holy Quran," *Int. J. Innov. Sci. Technol.*, vol. 7, no. 1, pp. 259–271, 2025, [Online]. Available: https://www.researchgate.net/publication/390549343_A_Deep_Learning_Approach_to_Semantic_Clarity_in_Urdu_Translations_of_the_Holy_Quran

[16] Zaigham Khaleeq, "Exploring Contextual Similarity in Quranic Ayahs: A Case Study of Surah Al-Baqarah and Aal-e-Imran in Urdu Translations," *Int. J. Innov. Sci. Technol.*, 2025, [Online]. Available: https://www.researchgate.net/publication/389624795_Exploring_Contextual_Similarity_in_Quranic_Ayahs_A_Case_Study_of_Surah_Al-Baqarah_and_Aal-e-Imran_in_Urdu_Translations

[17] D. Tariq, M., Awan, D. M. A., & Khaleeq, "Developing a Quranic QA System: Bridging Linguistic Gaps in Urdu Translation Using NLP and Transformer Model," *Int. J. Innov. Sci. Technol.*, vol. 7, no. 1, pp. 492–505, 2025, [Online]. Available: https://journal.50sea.com/index.php/IJIST/article/view/1216

[18] A. Daud, W. Khan, and D. Che, "Urdu language processing: a survey," *Artif. Intell. Rev.*, vol. 47, no. 3, pp. 279–311, Mar. 2017, doi: 10.1007/S10462-016-9482-X/METRICS.

[19] D. M. S. Zubair, Hassan Bin, Sadia, Dr. Saba, "A TRANSLATION STUDY OF SELECTED SURAHS OF HOLY QURAN ON COMPARATIVE ANALYTICAL BASIS OF HUMAN TRANSLATION VS MACHINE TRANSLATION," *Int. J. Linguist. Cult.*, vol. 1, no. 2, 2020, doi: https://doi.org/10.52700/ijlc.v1i2.21.

[20] N. N. Junaedi Setiyono, Bagiya Bagiya, "AUTHENTICITY AND READABILITY OF GOOGLE TRANSLATE TRANSLATING RELIGIOUS TEXTS RELATED TO CHARACTER EDUCATION WRITTEN IN ENGLISH INTO

INDONESIAN," *Konf. Linguist. Tah. Atma Jaya 21*, vol. 21, no. 21, 2023, doi: https://doi.org/10.25170/kolita.21.4848.

[21] C. Subakan, M. Ravanelli, S. Cornell, M. Bronzi, and J. Zhong, "Attention is all you need in speech separation," *ICASSP, IEEE Int. Conf. Acoust. Speech Signal Process. - Proc.*, vol. 2021-June, pp. 21–25, 2021, doi: 10.1109/ICASSP39728.2021.9413901.

[22] S. Baniata, L. H., Ampomah, I. K., & Park, "A Transformer-Based Neural Machine Translation Model for Arabic Dialects That Utilizes Subword Units," *Sensors*, vol. 21, no. 19, p. 6509, 2021, doi: https://doi.org/10.3390/s21196509.