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Challenges of Contextual Appropriacy in Machine Translation: An Analysis of Translations between Bangla and English

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Abstract: Machine Translation, henceforth MT, has made significant changes and simplified cross-linguistic communication in recent years, with advancements in neural networks showing promising results across various languages. However, achieving contextually appropriate translation remains a considerable challenge in MT, elucidating common errors in translation between Bangla and English, including problems with idiomatic expressions, cultural references, and contextual cues. This study illustrates the challenges of the MT system, focusing on Bangla to English translation and vice versa. Simultaneously, it has revealed the importance of maintaining grammatical correctness and syntactic coherence while preserving the cultural context of the source text. In addition, this study has analyzed popular MT models and tools, highlighting where context is crucial for accurate translation. The significance of this study is to break language barriers, accommodate linguistic and cultural subtleties, and foster multicultural understanding.

Keywords: Machine translation, context, appropriacy, challenges

Introduction

In recent years, MT has advanced significantly and revolutionized the field of translation. As noted in a survey by Hoi (2020), "it is found that machine translation is very popular among language learners. The percentage of people who "use it often" and "sometimes use it" is combined 75.7% in total" (p. 1920). Despite widespread use, its frequent misinterpretations create confusion and frustration among students. However, challenges remain in maintaining contextual appropriacy, specifically while translating between linguistically and culturally different languages, Bangla and English. As stated by Tan et al. (2020), "Neural machine translation has become the dominant approach to machine translation in both research and practice" (p. 18). Despite the advancements in MT with the rise of neural and statistical models, it fails to capture the accurate meaning and intention of the source text. A major challenge arises when translating idiomatic expressions, MT often produces literal translation which can be misleading. For example, 'কেঁচো খুঁড়তে সাপ' and 'গাছে কাঁঠাল গোঁফে তেল' are translated as 'snake digging for earthworms' and 'Jackfruit oil on the tree' by systems like Google Translate, which has failed to capture their intended meaning. Similarly, English idioms like 'costs an arm and a leg' is translated 'একটি হাত এবং একটি পা খরচ করে' in Google Translate, which is a word for word translation, losing its original sense. Understanding these issues is essential for enhancing the quality and reliability of MT. This research has focused on cross-cultural

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communication factors to analyze how cultural differences between Bangla and English speakers affect the interpretation and translation of texts. Specifically, it has examined how cultural values, beliefs, and norms are reflected in language use and how current MT systems are suffering from dealing these cultural distinctions. Hence, this study aimed to find out the difficulties of contextual appropriacy in MT while translating between Bangla and English and to investigate the factors that cause contextual errors.

Literature Review

MT has advanced with the rise of Neural MT models, such as Google Translate, Microsoft Translator, DeepL, bridging cross-linguistic communication. Despite these advancements, a major problem remains, which is contextual appropriacy. MT struggles with translating between Bangla and English due to deep cultural and syntactic differences. Bangla is a morphologically rich language with unique idioms, cultural references, which makes MT produce translations which may be grammatically correct, failing to convey the intended meaning.

Machine Translation

Machine Translation, a subfield of computational linguistics, refers to the use of computer software to translate texts from one language to other, usually with no human help. According to Slocum (1985), "MT systems are intended to perform translation without human intervention" (p. 2). MT has transitioned from rule-based system to statistical and neural models, making it a significant tool for global communication. Slocum (1985) also highlights that, "An MT system is solely responsible for the complete translation process from input of the source text to output of the target text without human assistance, using special programs, comprehensive dictionaries, and collections of linguistic rules" (p. 2). The idea of automating translation emerged during World War II, driven by the need to need to decode foreign communication. Hutchins (1995) implies,

The history of machine translation is traced from the pioneers and early systems of the 1950s and 1960s, the impact of the ALPAC report in the mid-1960s, the revival in the 1970s, the appearance of commercial and operational systems in the 1980s, research during the 1980s, new developments in research in the 1990s, and the growing use of systems in the past decade. (p. 431)

Problems of Contextual Appropriacy in Translation

Contextual appropriacy refers to the relevance of language use in a particular context, considering factors such as cultural norms, social settings, and intended meaning. However, generating contextually appropriate translation is a challenging task. Research by Naveen and Trojovsky (2024) indicates rule-based, statistical and neural MT systems, while improved, still struggle with various aspects of translation.

"Languages often contain ambiguous words or phrases with multiple meanings depending on the context" (Naveen & Trojovsky, 2024, p. 8). For example, the word 'date' can have multiple meanings; it can mean calendar day, romantic outing or a type of fruit. Likewise, in Bangla, the word 'শব্দ' in Bangla can mean both 'আওয়াজ বা অর্থবোধক বর্ণসমষ্টি. Understanding the context is crucial for generating accurate translations. Machine translation systems need to capture the meaning and intent behind the source text to produce contextually appropriate translations. For instance, if we say, 'The chicken is ready to eat' it may mean either the chicken (meal) is ready to eat or the chicken (bird) is ready to eat its meal. However, if we are aware of the context then we can understand it without any struggle. In Bangla, 'এখানে তার হাত রয়েছে' is translated as 'Here are his hands' in Google Translate. But it means 'He has a hand in this'. MT often fails with Bangla idioms, as literal translations result in nonsensical and contextually inappropriate outputs. For example, 'নিজের ঢাক নিজে পেটানো' is translated as 'beating your own drum' in Microsoft Translator. Here the concept of 'ঢাক' cannot be found in Western cultures and translated as drums. Cultural connotations like 'break a leg' is interpreted as 'একটি পা ভেঙ্গে দাও' in Google Translate, which can create miscommunication as it generally means 'good luck'.

MT has made significant strides, achieving contextually appropriate translations between Bangla and English still remains a challenge. This issue has not been addressed before for Bangla and English languages. This gap underscores the need for further research and development in MT algorithms.

Conceptual Framework

Communication is driven by the search for relevance. Speakers aim to convey information in a way that maximizes relevance for the listener, while listeners seek interpretations that offer the greatest cognitive effects for the least processing effort. In the context of MT, this means that a translation should not only be accurate but also relevant to the target audience, taking into account their background knowledge, cultural expectations, and the specific communicative situation. Contextual inappropriacies arise when the MT system fails to consider these relevance factors, producing translations that are either irrelevant or require excessive cognitive effort to interpret.

Again, contextual appropriateness is deeply intertwined with cultural understanding, as what is considered appropriate in one culture may be inappropriate in another. The flowchart below can be used to find the difficulties faced and factors that cause contextual inappropriacy in MT between Bangla and English.

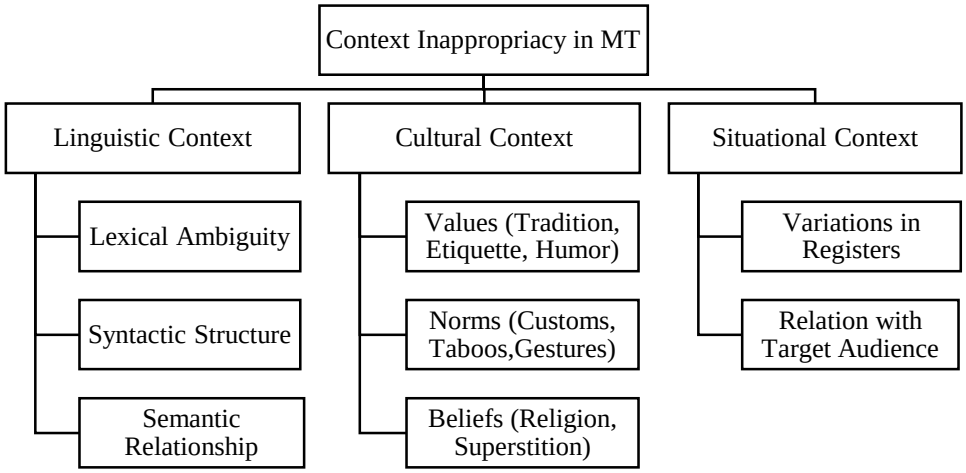


Figure 1. Types and factors of contextual inappropriacy in MT

By drawing on the above framework, the research aims to provide a comprehensive understanding of the problems of contextual appropriacy in MT between Bangla and English. It explores how linguistic and cultural factors interact to create challenges for MT systems and suggests potential directions for future research and development in this area.

Methodology

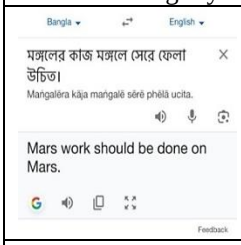
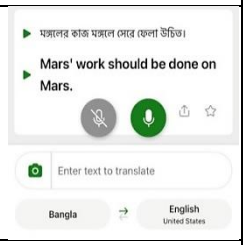
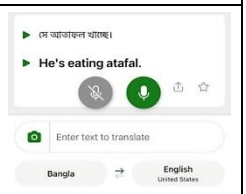
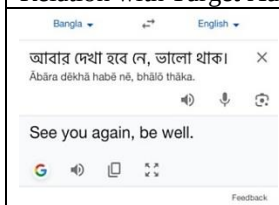
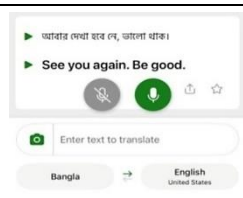
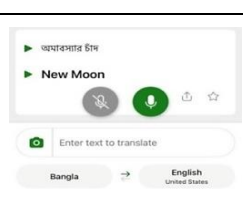
The current study is an explanatory research as it examines existing data to identify gaps for further research. The approach is qualitative as the study has been conducted to analyze the pattern of incorrect translations and understand the problems occurring because of contextual appropriacy in MT. For analyzing the data, we have used Exploratory Data Analysis (EDA).

Data were collected through Google Translate and Microsoft Translator. These have served as the primary instruments for generating translated texts. We have used purposive sampling where we have selected twenty sentences to illustrate the problems of contextual appropriacy in MT.

Analysis and Presentation of Data

This study delves into the challenges of contextual appropriacy in Machine Translation (MT), focusing specifically on the nuanced interplay between Bangla language and English language. Despite the significant strides in recent years, MT is still not able to handle context-sensitive meaning (See table 1.).

Table 1. Challenges of contextual appropriacy in machine translation: From Bangla to English

Google Translate	***Microsoft Translator***	***Google Translate***	***Microsoft Translator***
Lexical Ambiguity		Norms (Customs, Taboos, Gesture)	
			
Syntactic Ambiguity		Beliefs (Religion, Superstition)	
			
Semantic Structure		Variations in Registers	
			
Values (Traditions, Etiquette, Humor)		Relation with Target Audience	
			
Idiomatic Expression		Idiomatic Expression	
			

The problems encountered while translating from Bangla to English have been incorporated through some illustrative screenshots. The linguistic context, or also known as co-text, is the other words used in the same phrase or sentence, which help us understand the intended meaning (Yule, 2010). Where words and phrases are often depended on the context, MT fails to convey the intended meaning. It may arise at the levels of word sense, syntactic and semantic ambiguity and may lead to incorrect interpretations. For instance, the Bangla word 'মঙ্গল' can mean 'গ্রহবিশেষ' (Mars), সপ্তাহের বারবিশেষ (Tuesday), শুভ অথবা ভালো কিছু (Something good)'. But, both Google Translate and Microsoft Translator interpret 'মঙ্গল' as 'Mars', ignoring the contextual cues. The sentence presented in the preceding screenshots conveys 'if something good is to be done, it should be done on Tuesday'. The inherent polysemy of certain Bangla words creates confusion and ambiguity. Syntactic ambiguity is another challenge. Here, 'সে ভুল ছিল' does not clarify who is wrong as it can mean either 'ছাত্র' or 'শিক্ষক' or it can be completely about someone else. MT systems fail to resolve such ambiguity without contextual input. Additionally, MT struggles with choosing the right level of specificity. For instance, 'আতাফল' is translated as fruit, which hinders the accuracy of the translation. Hypernyms and hyponyms are crucial semantic hierarchies which affects the quality of the translations. Cultural context significantly affects MT quality.

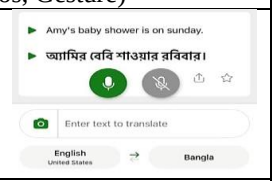
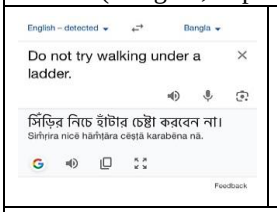
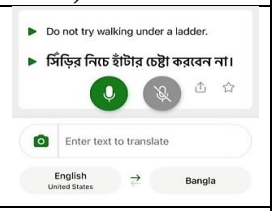
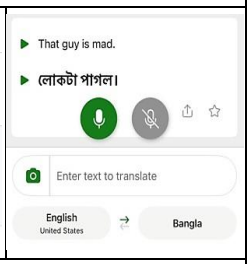
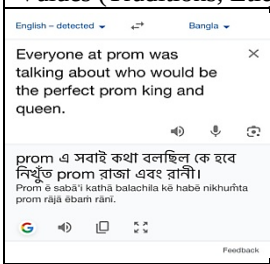
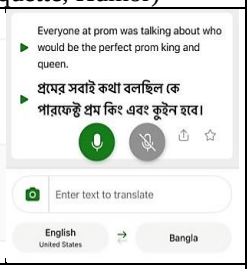
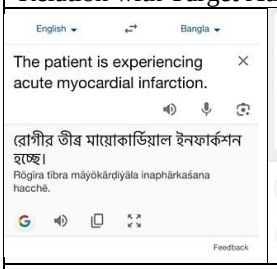
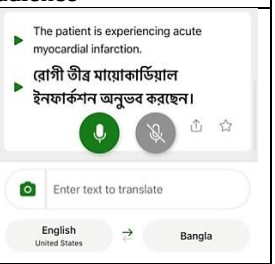
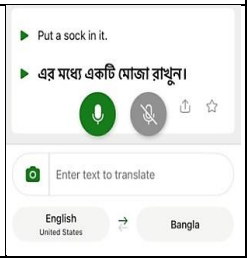
According to Itzchakov and Reis (2023), cultural context plays a crucial role in communication. It shapes communication norms, expectations and behaviors. Cultural factors also influence how people enact, respond and interpret. Cultural nuances, such as values, idioms, norms, beliefs are often mistranslated. It fails to capture culturally embedded emotions and scenarios. For example, 'শীতের সকালে টঙে চা আর জম্পেশ আড্ডা!' refers to the cherished Bangali custom of lively socializing over tea at roadside stall, which is an unfamiliar concept in Western context. MT produces literal translation ignoring the emotional and cultural weight behind such expression. Idioms are deeply rooted in both the culture and history of a language, which reflects its values, tradition, and belief. MT often fails to capture the intended meaning of these expressions. For instance, the Bangla idiom 'পিঁড়েয় বসে পেঁড়োর খবর' means someone who knows all the village gossips while staying at home or 'ঘরের বারান্দায় বসে রাজধানীর খবর পাওয়া'. But here both the MT systems render it nonsensically as 'The news of the old man sitting on the old man' and 'News of the sitting pig'. Similarly, 'অমাবস্যার চাঁদ' used to describe someone rarely seen, is translated literally as 'new moon', missing the figurative sense. MT fails to capture the context with customs. For example, 'নববর্ষ', 'পান্তা ইলিশ' these words require cultural understanding, or here Bangali culture. Both the MT systems have translated the line literally but it did not capture that this is a traditional meal for Pohela Baishakh (Bangla New Year), symbolizing prosperity.

Further, superstitions and traditional beliefs are culture-specific and difficult to interpret. The phrase 'রাতের বেলায় তেঁতুল তলায় যাসনা' a cultural warning rooted in local superstition, is translated literally without capturing its cautionary undertone. Situational context, which involves social roles, relationships and the purpose of communication, is another layer where MT systems struggle. The use of Bangla pronouns 'আপনি, তুমি, তুই' reflects the level of politeness and formality. The example used above refers to a casual register where one is addressing other 'তুই' and shares a friendly bond. MT struggles to capture subtle meanings. Effective translation depends on audience needs, including cultural sensitivity, formality, and tone, areas where MT systems fail to convey underlying emotion.

Again, MT systems often face challenges in maintaining contextual appropriacy for a variety of reasons. In the table 2 below, we have attempted to translate texts from English to Bangla to illustrate these issues. Lexical ambiguity remains one of the major challenges in MT. For example, the word 'fair' can mean light-skinned, just or a carnival. MT systems cannot accurately identify the intended meaning without the contextual understanding. Similarly, 'He likes her more than me' can be interpreted in two ways, but both Google Translate and Microsoft Translator produced a single Bangla translation which can be misleading. It shows MT's inability to resolve the syntactic ambiguity. On the other hand, words with similar meanings can have different connotations. For instance, the word 'mad' can mean both insane and angry. However, both the MT systems translated

it as insane, which may not be accurate if the intended meaning was angry. Such semantic inaccuracies arise due to the lack of contextual understanding. Cultural references further complicate MT systems.

Table 2. Challenges of contextual appropriacy in machine translation: From English to Bangla

Google Translate	***Microsoft Translator***	***Google Translate***	***Microsoft Translator***
Lexical Ambiguity		Norms (Customs, Taboos, Gesture)	
			
Syntactic Ambiguity		Beliefs (Religion, Superstition)	
			
Semantic Structure		Variations in Registers	
			
Values (Traditions, Etiquette, Humor)		Relation with Target Audience	
			
Idiomatic Expression		Idiomatic Expression	
			

For example, words like ‘prom’ or ‘baby shower’ which is elated to western tradition or custom are unfamiliar to us. And both the MT systems left them untranslated. ‘Baby shower’ is interpreted as ‘বেবি শাওয়ার’, which carries no meaning for Bangla speakers. Without cultural adaptation, MT systems produce outputs that are contextually inappropriate and confusing. Idioms are one of the most problematic challenges in MT systems. Idioms are deeply intertwined with culture, because they reflect a society’s history, tradition, values etc. Phrases like ‘put a sock in it’ or ‘all hat and no cattle’ are translated word-for-word, leading to meaningless Bangla outputs. Therefore, MT has its shortcomings in capturing the context of certain expressions. Additionally, superstitions and beliefs, such as ‘walking under a ladder’ have cultural significance to the West but do not carry any meaning in Bangali culture. MT fails to render their symbolic meaning when dealing with culturally loaded content. Register variation is another critical issue. MT systems often fail to distinguish between formal and informal tone. For instance, casual slang like ‘chill at Macy’s’ is translated as ‘চিল করতে চান’ which is a formal tone. MT distorts the original intent of the text. Likewise, the target audience significantly affects translation quality. In the preceding screenshot, the target audience or Bangali audience cannot understand the technical term, myocardial infarction. This is an industry specific language, also known as jargon, which doctors or medical students may understand but if the audience is a Bangali patient then s/he may not understand what it means and therefore, create miscommunication.

Findings and Discussion

This MT fails to interpret the accurate translations, despite the progression, due to linguistic, cultural and situational factors. This study has identified the difficulties MT faces due to the lack of contextual understanding and the factors that cause contextual errors. These challenges are analyzed and summarized in the table below, highlighting the difficulties faced by MT.

Table 3. Difficulties of Contextual Appropriacy in MT

Difficulties	Descriptions
Lexical Ambiguity	Words with multiple meanings or polysemous words are often interpreted wrong by MT. Words like ‘মঙ্গল’ (which can mean ‘mars’, ‘Tuesday’ ‘something good’ was consistently translated as mars), ‘fair’ serves multiple meaning. MT has ignored the intended meaning due to the lack of contextual understanding.
Syntactic Ambiguity	MT cannot capture the meanings of sentences with multiple possible meanings. For example, ‘he likes her more than me’ was mistranslated by MT because it could not understand due to the ambiguity in sentences caused by context.
Semantic Relationship	Due to the lack of linguistic contextual understanding, MT failed to differentiate between general and specific terms. MT struggles with hypernyms, hyponyms, and synonyms. For instance, ‘আতাফল’ was translated as ‘fruit’ instead of the specific fruit type, which has led to the loss of meaning.
Idiomatic Expressions	MT struggles the most with idiomatic phrases as idioms are directly connected to culture, historical background, and traditions of a particular community. Therefore, a literal translation by MT leads to miscommunication between communities and sometimes become offensive.
Variations in Register	MT does not adjust translations based on formality. MT does not differentiate between Bangla pronouns (আপনি, তুমি, তুই), which convey the levels of politeness. It translates informal speech very formally which affects the appropriacy of the translations.
Values, Norms and Beliefs	These are intertwined with one community’s culture. Without the cultural contextual understanding, MT fails to capture the core meaning, which we have encountered here.
Relation with Target Audience	MT does not account who the target audience is, which leads to confusion, especially in fields like law, medicine, literature. Again, it struggles with the formal versus informal tone.

The primary difficulties of contextual appropriacy arise from differences between some fundamental linguistic, cultural and situational factors. Being linguistically two distinct languages, MT struggles with interpreting multiple meanings of words, phrases, sentences. Bangla and English language are culturally very different, and the absence of contextual adaptation causes MT to misinterpret idioms, traditions, social customs, religious beliefs etc. MT systems also lack situational awareness, therefore, produce translations that may have grammatical consistency, or may not have,

but can be contextually inappropriate. As Cairns (1988) states, "The greatest disadvantage of the machines in existence today is that they cannot see beyond sentence level (to some extent word level) and they are working on a small scale without having any idea what the text as a whole is about" (pp. 63-64). These findings confirm that MT struggles with context. This often leads to offensive, unnatural, or misleading translations, highlighting the need for context-aware systems.

Conclusion

This study highlights the importance of context in translation and shows how achieving a fully contextual appropriacy still remains a significant challenge for MT systems, providing an in-depth analysis. No study, which focuses on translations between Bangla and English, has not yet been covered in existing literatures. Despite the advancements, MT fails to handle context derived meaning due to critical issues, such as, cultural references, polysemy, idiomatic expressions, and register variations. This study presents a detailed investigation where MT misinterpreted the intended meaning, which eventually produced unnatural and awkward translations. The syntactic and semantic differences between Bangla and English complicate the translation process.

This study can help the future researchers, interested in the field of translation and in improving the quality of MT, especially for languages like Bangla and English for their unique complexities. Further studies can incorporate the contextual understanding in MT systems so that it can produce linguistically and culturally appropriate translations. In addition, future works can include large datasets, user feedbacks to improve the quality of Machine Translation systems.

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