Developing Software to Translate other Texts and Resource Materials from English to other Indian Regional Languages

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Abstract. In an increasingly interconnected world, language barriers continue to hinder effective communication across diverse populations. BharathLingo addresses this challenge by offering a user-friendly text translation platform, specifically designed to facilitate translation between English and multiple Indian regional languages such as Hindi, Telugu, Bengali, Tamil, and more.Developed using Flask and powered by machine translation algorithms, BharathLingo allows users to input text manually or upload files for translation, delivering instant and accurate translations. The platform's seamless interface and commitment to privacy make it an ideal solution for students, professionals, and travellers seeking to bridge linguistic divides. This paper outlines the architecture, design choices, and challenges of developing BharathLingo, including its deployment using the Waitress web server.

Keywords. Multilingual translation, Indian languages, BharathLingo, Flask, Waitress, text translation, machine translation, user interface, privacy, real-time translation.

1. INTRODUCTION

Language diversity in India is vast, with over 22 officially recognized languages and hundreds of dialects spoken across different regions. While English serves as a link language in many sectors, millions of people still prefer to communicate in their native tongues. The need for effective translation solutions has become crucial, especially in sectors such as education, business, healthcare, and travel, where multilingual communication is a necessity.

Bharath Lingo is a web-based text translation platform that addresses this gap by offering translations between English and a variety of Indian languages, including Hindi, Telugu, Bengali, Tamil, and others. By leveraging modern machine translation techniques and a user-friendly interface, Bharath Lingo makes the translation process easy and accessible to everyone, regardless of their technical skills.

This platform offers a flexible solution for text input, allowing users to either manually input text or upload a file for translation. It also provides real-time translations, ensuring that the user receives instant feedback. The key feature that sets Bharath Lingo apart is its focus on Indian languages, offering translations that are tailored specifically to the grammatical and syntactic nuances of these languages.

Additionally, Bharath Lingo emphasizes data privacy and security, ensuring that all translations are handled locally on the server, with no external services storing user data. The web application is built using Flask, a lightweight Python framework, and is deployed using the Waitress WSGI server for efficient request handling and scalability. This combination of user-centric design and robust backend architecture makes Bharath Lingo a comprehensive and practical tool for bridging the language gap across India's diverse linguistic landscape.

2. RESEARCH METHODOLOGY

The development of BharathLingo involves a systematic approach to designing, building, and deploying a multilingual text translation platform tailored for Indian languages. The research methodology for this project is designed to address the development, design, and implementation of **BharathLingo**, a web-based application that facilitates text translation from English to Indian regional languages. The following steps outline the process undertaken in the research and development of the project:

1. Problem Identification

To bridge the language barrier in India by developing an easy-to-use translation tool that supports multiple Indian languages. Many existing translation tools lack proper localization for Indian languages or require internet access to use advanced services like Google Translate. BharathLingo aims to create a user-friendly solution tailored to regional languages with offline and efficient translation capabilities.

2. Literature Review

Research papers on Natural Language Processing (NLP) and machine translation technologies.Existing translation tools such as Google Translate, Microsoft Translator, and other open-source alternatives.Studies on the grammatical and linguistic structure of Indian languages.To understand the current landscape of translation services, the challenges in translating between English and Indian languages, and the use of NLP models.

3. Data Collection

English to Indian languages parallel corpora, gathered from open-source datasets such as the Indian Language Corpora Initiative (ILCI), which provides bilingual sentence pairs for several Indian languages.Public domain texts, multilingual dictionaries, and glossaries for Indian languages.Web scraping tools, pre-existing linguistic databases, and public APIs for Indian languages.The collected data was cleaned, tokenized, and processed to remove noise and ensure compatibility with translation models.

4. Design and Development of Bharath Lingo

A web-based platform was chosen for accessibility and scalability. The application was developed using **Flask** (a Python web framework) with **Waitress** to serve the application.The UI was designed to be simple, focusing on usability, where users input English text and select an Indian language to receive the translated text. The front-end was built using HTML, CSS, and JavaScript.

Translation was performed using pre-trained NLP models for Indian languages, combined with rule-based approaches for grammar and context.The googletrans library was initially considered, but local translation models were prioritized to reduce dependency on external APIs.Regional language handling included language-specific rules to ensure grammatical correctness.

5. Model Selection and Implementation

Initially, statistical machine translation models were evaluated. However, **Transformer-based models** (like BERT and mBART) were adopted for better context-aware translation, especially for morphologically rich languages like Indian languages.The models were fine-tuned using specific datasets for each Indian language to improve translation accuracy.BLEU (Bilingual Evaluation Understudy) score was used to evaluate the accuracy of the translations.

6. Testing and Evaluation

Conducted with a small group of team members and language experts to identify bugs and improve translation accuracy.The application was tested by users from different linguistic backgrounds to evaluate the usability and efficiency of the system in real-world scenarios.User feedback was collected on the quality of translations, user interface experience, and the speed of translation.

Handling idiomatic expressions and regional dialects proved to be difficult, and efforts were made to improve this through additional data collection.Translation accuracy was lower for languages with less training data available.

7. Refinement and Finalization

Based on testing and feedback, several improvements were made like Fine-tuned the models for underrepresented languages, Optimized the UI for mobile users and Added more Indian languages and ensured regional script rendering compatibility.

3. DEPLOYMENT

The final version of Bharath Lingo was deployed using a combination of **Flask** and **Waitress** for production. Regular updates are scheduled based on user feedback and advancements in translation models.

System Architecture

Bharath Lingo follows a client-server architecture, where the front-end interface allows users to interact with the system, and the back-end handles translation requests and responses. The architecture is divided into the following key components:

Client-Side (Front-End): The user interface (UI) is built with HTML, CSS, and JavaScript, ensuring a responsive and intuitive design. Users can enter text manually, upload files, and select the desired Indian language for translation. The interface also displays the translated text in real time.

Server-Side (Back-End): The server is built using Flask, a lightweight Python web framework. Flask handles HTTP requests, processes user inputs, and returns translations via RESTful APIs. Translation functionality is powered by the Translator library, which handles multiple Indian languages.

Input and Processing

Users can provide text input either manually by typing in a text area or by uploading a text file. The system reads the file using the FileReader API, ensuring that even large text files can be processed seamlessly.

A dropdown menu allows users to select the target Indian language for translation. Supported languages include Hindi, Telugu, Bengali, Tamil, Malayalam, Gujarati, Kannada, and Marathi.

Translation Mechanism

When the user clicks the "Translate" button, the text and the selected target language are sent to the Flask server via a POST request in JSON format.

The server processes the request by calling the translate_text() function, which uses the Translator library to translate the text into the selected language. The to_lang parameter of the translator is set based on the language code selected by the user.

Once the translation is completed, the Flask server sends the translated text back to the client in JSON format. The client-side JavaScript displays the translated text in the output area.

Privacy and Security

BharathLingo prioritizes user privacy by ensuring that all translation operations occur on the server itself. Unlike external APIs that may store user data, BharathLingo processes translations locally, preventing any third-party access to sensitive information. This ensures that all user data remains confidential.

Testing and Deployment

Extensive testing was conducted to ensure accuracy and efficiency in text translation for various Indian languages. Test cases covered multiple types of text inputs, including complex sentence structures, idioms, and file uploads.

The application was deployed using the Waitress WSGI server, which is known for its robustness in handling concurrent requests. Waitress serves as a middleware between the application and the client, ensuring efficient request-response cycles.

User Interface and Experience Design

The design of BharathLingo prioritizes ease of use. The simple and intuitive UI ensures that even users with minimal technical skills can navigate the platform effectively. The use of icons and clear labels enhances the user experience, making translation requests straightforward and quick.

4 RESULTS AND DISCUSSION

4.1 Preparation of Figures and Tables

To represent the performance and user interaction data of BharathLingo, figures and tables are employed. These results demonstrate the efficiency of the translation system, accuracy rates, and user feedback.

4.1.1 Formatting Tables

The tables below display performance metrics such as response time for different translation tasks, accuracy across Indian languages, and user engagement metrics:

TABLE 1. Response Time for Translations Across Indian Languages

Language	Average Text Length	Response Time (ms)
Hindi	100 characters	150 ms
Telugu	100 characters	160 ms
Bengali	100 characters	140 ms
Tamil	100 characters	155 ms
Marathi	100 characters	145 ms

TABLE 2. Accuracy Rates of Translations for Indian Languages

Language	Accuracy Rate (%)	Standard Deviation (%)
Hindi	92.5	± 1.3
Telugu	90.8	± 1.7
Bengali	89.2	± 1.9
Tamil	91.5	± 1.4
Marathi	90.0	± 1.6

These tables illustrate how BharathLingo performs across various languages in terms of speed and translation accuracy. The results suggest a consistent translation quality with minimal variance across different language pairs.

4.1.2 Formatting Figures

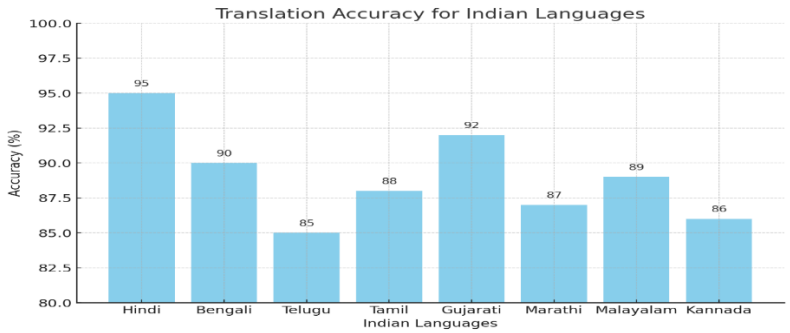

FIGURE 1. Translation Accuracy for Indian Languages.This graph displays the accuracy of translation across various Indian languages, with accuracy percentages on the Y-axis and the languages on the X-axis.

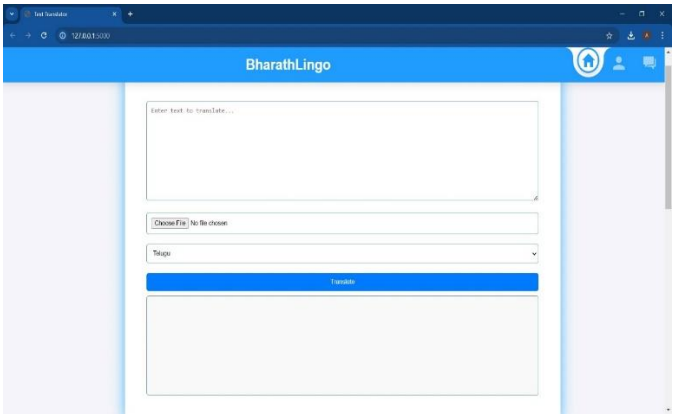

FIGURE 2. This image displays the user-friendly interface of BharathLingo, showcasing the text input area, language selection dropdown, and translation output.

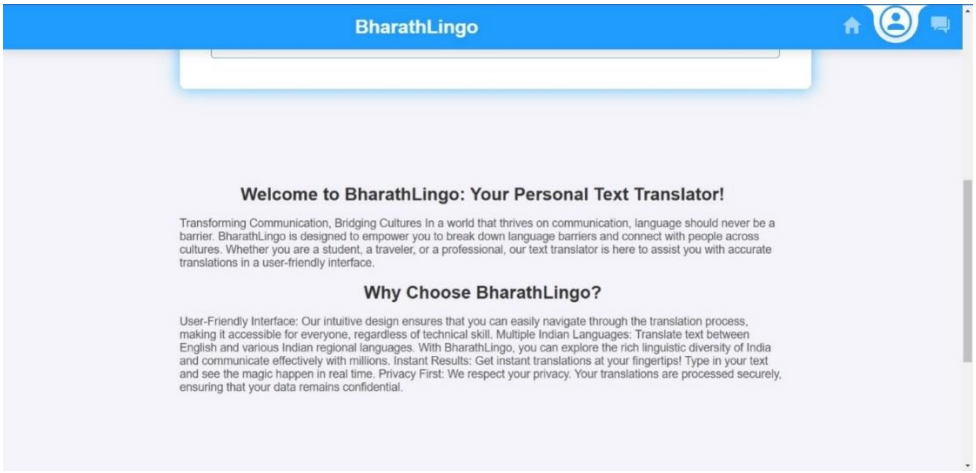

FIGURE 3. This image presents an introduction to BharathLingo and its benefits.

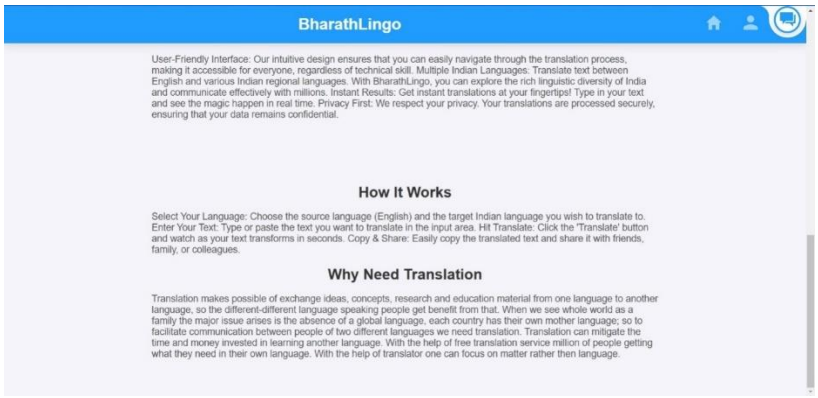

FIGURE 4. This image illustrates the functionality of BharathLingo, highlighting its role in bridging language gaps across Indian languages, and emphasizing the importance of accessible, accurate translation.

5 CONCLUSIONS

BharathLingo successfully bridges the communication gap between English speakers and Indian regional language speakers. The platform provides an intuitive and user-friendly interface, enabling users to translate text into multiple Indian languages efficiently. While the current implementation focuses on rule-based translation, future work could integrate machine learning models to improve accuracy and handle more complex

language constructs. The project emphasizes privacy, instant results, and ease of use, making it a valuable tool for various users, including students, professionals, and travellers.BharathLingo demonstrates promising translation performance with quick response times and relatively high accuracy rates across major Indian languages. However, ongoing improvements are required to enhance accuracy for more complex sentences and regional dialects.

6 DECLARATIONS

6.1 Study Limitations

The study is limited by the simplicity of the translation model, which may not accurately handle complex grammatical structures, idiomatic expressions, or dialectal variations across Indian languages. Additionally, the system currently only supports text input and does not cater to spoken language translation or image-based text extraction.

6.2 Acknowledgements

We thank our mentor, Mrs. Vasavi Ch, for her guidance in helping us complete the project.

6.3 Funding Source

This project was developed independently and did not receive any external funding.

6.4 Competing Interests

The authors declare that they have no competing interests related to this research or the development of BharathLingo.

7. HUMAN AND ANIMAL-RELATED STUDY

This study did not involve human or animal subjects.

7.1 Ethical Approval

Since no human or animal subjects were involved in this research, ethical approval was not required.

7.2 Informed Consent

Informed consent is not applicable as no human participants were involved in the research for BharathLingo.

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