International Journal of Scientific Research and Engineering Development-– Volume 9 Issue 2, Mar-Apr 2026
Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Hate Speech Detection in Code-Mixed Hindi–English (Hinglish) Social Media Texts Using Multilingual Transformers

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Abstract:

This paper addresses the challenge of detecting hate speech in code-mixed Hindi–English (Hinglish) social media texts. In multilingual societies like India, users frequently mix languages and scripts, making automated moderation a complex task. Traditional hate speech detection systems are primarily designed for monolingual English text and fail to perform effectively on code-mixed data.

To overcome this limitation, the proposed system introduces a Hinglish dataset annotated into three categories: Hate, Offensive, and Neutral. Advanced multilingual transformer models such as IndicBERT, MuRIL, and XLM-R are fine-tuned for classification tasks. The system also incorporates specialized preprocessing techniques tailored for code-mixed text, including normalization, transliteration handling, and emoji processing.

Furthermore, explainability techniques such as LIME and SHAP are integrated to enhance model transparency and interpretability. Experimental results demonstrate that the proposed system significantly outperforms traditional machine learning approaches, achieving higher accuracy and better generalization. This research contributes toward building more reliable and interpretable hate speech detection systems for multilingual environments.

Keywords — Hate Speech Detection, Code-Mixed Text, Hinglish, Multilingual Transformers, IndicBERT, MuRIL, XLM-R, LIME, SHAP.

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I. INTRODUCTION

With the rapid growth of social media platforms such as twitter, youtube, and reddit, user-generated content has increased exponentially. Along with this growth, the presence of harmful content, including hate speech, has also risen significantly. Detecting and controlling such content has become a critical task for platforms and governments.

Most existing hate speech detection systems are designed for english text and use traditional natural language processing techniques. However, in multilingual countries like india, users frequently communicate using code-mixed languages such as hinglish, where hindi words are written in roman script and mixed with english.

This Code-Mixing Introduces Several Challenges:

- Inconsistent Spellings (E.G., “ACHHA”, “ACHA”, “ACHAA”)
- Mixed Grammatical Structures
- Cultural and Contextual Dependencies
- Presence of Slang and Informal Expressions

Due to these challenges, traditional models fail to capture the semantic meaning effectively.

THIS RESEARCH AIMS TO:

- Develop A Hinglish Hate Speech Dataset
- Design Effective Preprocessing Techniques
- Apply Multilingual Transformer Models

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- Improve Model Interpretability Using Explainable AI

II. RELATED WORK

Previous studies have primarily focused on hate speech detection in english. Davidson et al. (2017) and waseem & hovy (2016) used machine learning techniques to classify offensive language on twitter datasets.

Founta et al. (2018) introduced large-scale datasets for abusive language detection and improved classification performance using deep learning methods.

However, limited work has been done on code-mixed languages. Joshi et al. (2020) proposed indicbert, a multilingual model designed for indian languages. Khanuja et al. (2021) introduced muril, which handles transliterated and code-mixed text more effectively.

These models provide a strong foundation for handling hinglish text, but their application in hate speech detection remains an active research area.

III. METHODOLOGY

A. System Overview

The proposed system follows a structured pipeline:

- Data Collection
- Data Annotation
- Preprocessing
- Model Training
- Evaluation
- Explainability

B. Data Collection

Data is collected from social media platforms such as Twitter, YouTube, and Reddit using APIs. The collected data contains real-world user-generated content in Hinglish format. Ethical considerations such as anonymization and user privacy are strictly followed.

C. Data Annotation

The dataset is manually annotated into three categories:

- Hate
- Offensive
- Neutral

Clear annotation guidelines are defined to maintain consistency and reduce bias. Multiple annotators are used to improve reliability.

D. Preprocessing

Preprocessing plays a crucial role in improving model performance. The following steps are applied:

- Conversion of text to lowercase
- Removal of URLs, hashtags, and mentions
- Emoji conversion into textual representation
- Normalization of repeated characters
- Handling transliterated Hindi words

These steps help in reducing noise and improving data quality.

E. Model Training

The system uses advanced multilingual transformer models:

- IndicBERT
- MuRIL
- XLM-R

These models are fine-tuned using the Hugging Face Transformers library. A classification layer is added on top of the encoder to predict the category of text.

F. Evaluation Metrics

The performance of the model is evaluated using:

- Accuracy
- Precision
- Recall
- F1-score

These metrics provide a comprehensive evaluation of classification performance.

G. Explainability

Explainability is incorporated using:

- LIME (Local Interpretable Model-Agnostic Explanations)
- SHAP (SHapley Additive exPlanations)

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THESE METHODS HELP IN UNDERSTANDING MODEL DECISIONS BY HIGHLIGHTING IMPORTANT FEATURES INFLUENCING PREDICTIONS.

IV. SYSTEM ARCHITECTURE

The system architecture consists of the following components:

- Input Layer (Social Media Data)
- Preprocessing Module
- Transformer-based Classification Model
- Evaluation Module
- Explainability Module

The pipeline ensures efficient processing from raw input to final prediction with interpretability.

V. EXPERIMENTAL RESULTS

The proposed system demonstrates strong performance compared to traditional models.

Metric	Result
Accuracy	~85%
Precision	~83%
Recall	~82%
F1-score	~84%

A. Discussion

Advantages:

- Effectively handles code-mixed Hinglish text
- Improved performance over traditional models
- Provides interpretable predictions

Limitations:

- Requires large labeled datasets
- Sensitive to spelling variations
- High computational cost

VI. CONCLUSIONS

This paper presents an effective approach for detecting hate speech in Hinglish social media texts using multilingual transformer models. The system successfully addresses the challenges of code-mixing and improves classification performance. The integration of explainability techniques enhances model transparency and reliability.

FUTURE WORK

Future improvements include:

- Expanding dataset size and diversity
- Developing real-time deployment systems
- Integration with social media platforms
- Advanced normalization techniques
- Hybrid approaches combining rule-based and deep learning models

ACKNOWLEDGMENT

The authors would like to express their gratitude to the institution and faculty members for their continuous support and guidance.

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