

# SUPPORT VECTOR MACHINES FOR ANALYZING FOR CODE SWITCHING AND CODE MIXING IN RURAL INDIAN LANGUAGES

**Dr. Denis Vaz**

Assistant Professor, Rosary College of Commerce & Arts

**Abstract:** Code mixing is some one uses one word or phrase from one language to another language and Code Switching is the process of using entire sentences ,phrases and borrowed vocabulary from a different language . In this research paper ,we proposes a method which shows the potential of Support Vector Machines (SVM) as a computational tool for pattern recognition and understanding of code switching and code mixing in rural Indian languages. We Propose SVM-based technique for accurately locating occurrences of code switching and code mixing in natural language texts. In this approach SVM method is used to classify Code switching and Code Mixing texts from a large data set. Texts are classified for from SVM and results are showed Code Mixing and Code Switching texts separately.

Keyword: Code switching, Code mixing, Rural Indian languages, Support Vector Machines, , Multilingualism, , Linguistic analysis, ,

## **Introduction:**

Significant complications arise when analyzing code switching and code mixing, which are common linguistic processes in multilingual settings, particularly for rural Indian languages.[1]; We investigate the potential of Support Vector Machines (SVM) as a computational tool for pattern detection and comprehension of code flipping and mixing in rural Indian languages in this study. For precisely finding instances of code switching and code mixing in natural language texts, we provide a specific SVM-based method. This method makes use of linguistic traits and contextual data. India's multiplicity of languages makes it an interesting place to research code switching and code mixing. Due to scarce resources and weak linguistic documentation, rural Indian languages in particular pose a special set of difficulties for academics. In addition to advancing linguistics research, understanding code switching and code mixing in rural Indian languages is essential for developing inclusive language technologies and educational methods that serve these many linguistic populations. Recent developments in computer linguistics and natural language processing (NLP) have shown significant promise for understanding linguistic processes. Numerous NLP jobs typically make use of the well-known machine learning technology Support Vector Machines (SVM). However, its application to studying code flipping and code mixing in rural Indian languages hasn't been properly explored. Code of Cultural Inclusion The phrase "mixing in Indian Languages" describes the linguistic phenomena in which speakers smoothly incorporate words from other languages into their speech, resulting in a distinctive linguistic fusion that represents India's extensive cultural legacy. This custom is firmly ingrained in India's multilingual population and is essential for fostering intercultural communication, social solidarity, and cultural exchange.[1]; Indian culture frequently uses code switching, which reflects the multilingual and multicultural nature of the nation. It refers to the seamless and intentional shift between two languages or dialects in a same statement, conversation, or other utterance. There are many social, cultural, and practical uses for code flipping in India, where it is an essential component of daily communication.[2]; Code-switching in Indian culture is a remarkable linguistic phenomena that illustrates India's extensive and

multilingual heritage. Each language in India has a unique writing system, sonic characteristics, and cultural significance. As a result, code-switching has become an essential part of daily communication for many Indians and has been shown to be a highly efficient strategy for negotiating the complexities of the linguistic landscape. A speaker who alternates between two or more languages or linguistic subtypes while speaking in a dialogue or discourse is said to be "code-switching." [2]; It entails deliberate and seamless language switching, usually at the sentence or phrase level. When people are fluent in several languages and use them interchangeably depending on the social, cultural, or situational circumstances, this practice of code-switching is frequent in multilingual societies. Speakers can express their cultural identity, accommodate interlocutors who speak other languages, convey nuanced meanings, or make up for word shortages through this dynamic verbal activity. The speaker's capacity to transition between languages as needed in a variety of social and linguistic circumstances demonstrates their linguistic diversity and flexibility.

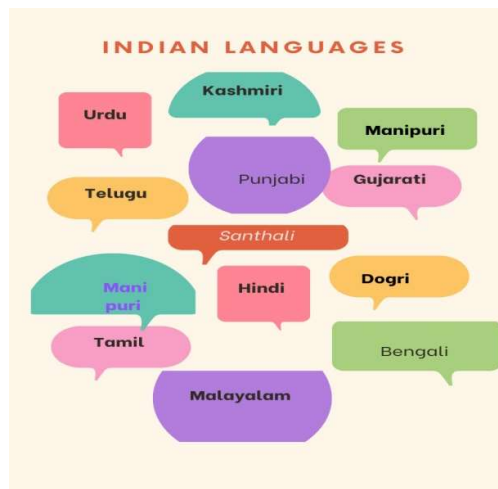


Fig 1 :Indian Languages

This study aims to fill this gap by suggesting and evaluating an SVM-based strategy for the detection and analysis of instances of code switching and code mixing in rural Indian languages [3]; The major aims of this study are to investigate the distribution and frequency of these linguistic occurrences in rural Indian languages and to develop a reliable computer algorithm that can identify code switching and code mixing in natural language texts. Through extensive experiments and evaluations on various language datasets, we hope to show how well the SVM-based approach captures the complex interplay of languages and offer insights into the sociolinguistic factors that affect code switching and code mixing in rural Indian communities.

**Code Mixing and and Code Switching** :Code Switching and Code Mixing The phrase "mixing in Indian Languages" describes the linguistic phenomena in which speakers smoothly incorporate words from other languages into their speech, resulting in a distinctive linguistic fusion that represents India's extensive cultural legacy. This custom is firmly ingrained in India's multilingual population and is essential for fostering intercultural communication, social solidarity, and cultural exchange.

This study aims to advance the field of computational analysis and linguistics, as well as linguistic preservation efforts, inclusive language technologies, and multilingual communication strategies, by advancing our understanding of code switching and code mixing in rural Indian languages. The study's conclusions may, in the end, have wider ramifications for the formulation of language plans and policies, promoting greater linguistic and cultural inclusivity in communities with a variety of languages and cultures.



Fig 2 :Code mixing and code Switching

For many Indians, being multilingual is not simply a trait but also a way of life. People effortlessly switch between languages in different places, frequently during the same conversation. The complicated multilingual surroundings that people face on a daily basis prompt a natural response in the form of code mixing and switching, a sophisticated dance of linguistic codes. Language interaction occurs everywhere in offices, schools, marketplaces, and even on digital platforms providing a rich field of study for linguists. Code switching is a frequent linguistic phenomenon in Indian culture, reflecting the multilingual and multicultural nature of the country. The seamless and deliberate switching between two languages or dialects within the same speech, conversation, or other utterance is referred to as this. Code-switching is common in multilingual societies, when people are proficient in numerous languages and use them interchangeably depending on the social, cultural, or situational circumstances.

Through this dynamic linguistic activity, speakers can express their cultural identity, accommodate interlocutors who speak other languages, convey delicate meanings, or fill up word shortages. The speaker's linguistic diversity and flexibility are shown by their ability to switch between languages as necessary in a variety of social and linguistic contexts.

### **Code mixing pattern in Indian Regional Languages:**

The smooth blending of material from many languages within a single dialogue defines code mixing patterns in Indian regional languages. The multilingualism of Indian society and the country's diversified cultural landscape are both reflected in this language phenomenon. Lexical borrowing from other languages, code mixing with Hindi and English, the development of hybrid nouns and adjectives, and the inclusion of idioms and cultural terminology are examples of common code mixing patterns. Additionally, the extensive Sanskrit influence in many regional languages is frequently used in code mixing. Education, urbanization, and the long-standing coexistence of several languages in particular places are all factors that have an impact on the occurrence of code mixing. It highlights the vibrant and inclusive aspect of Indian culture by acting as a bridge for effective communication and cultural exchange.

Indian regional languages' patterns of code mixing reveal an intriguing interaction between linguistic variation and cultural influences. Code mixing arises as a natural linguistic occurrence since numerous languages and dialects coexist in various parts of the country. In order to shed light on the causes influencing their utilization, this section examines several common code mixing patterns in Indian regional languages.

Because India is a country with many different languages, code mixing and switching are frequently seen in regional Indian languages. Examples of code switching and code mixing in regional Indian languages are as follows:

1. Hindi-English Code Mixing The office is "office."

"I have to go to work today," in translation.

The speaker in this instance blends Hindi and English by using the Hindi term "आज" (today) coupled with along with the English word "office" in the same sentence.

2. Code Switching (Bengali to English): " Later, I'll give you a call.

The speaker alternates between Bengali and English in this line, utilizing the English word "later" and the Bengali phrase "I will call you."

3. Tamil-English Code Mixing: "What's for dinner?"

Translated: "Where can we go for dinner?"

Here, the speaker combines Tamil and English by posing the same query using both the English term "for dinner" and the Tamil word "எங்க" (where).

4. Code Switching in Marathi and Hindi: " ?"

"Where are you going?" translated.

With the Marathi pronoun "तू" (you) and the Hindi verb "जा रहे हैं" (are going), the speaker now shifts from Marathi to Hindi.

5. Kannada-English Code Mixing: "has beautiful colors."

"This bird has beautiful colors," translated.

Here, the speaker combines Kannada and English by putting the English word "bird" in the same sentence as the Kannada demonstrative "ಇದು" (this). Indian regional languages naturally use code switching and mixing, which reflects the nation's multiculturalism and multilingualism. They make it possible for speakers to communicate and express themselves clearly.

**Intra-Sentential Code Mixing:** When speakers combine parts from various languages within the same sentence or clause, this phenomenon is known as intra-sentential code mixing or intra-clausal mixing. An example of this would be the use of English loanwords for contemporary ideas or technical jargon in a phrase written in a South Indian language like Tamil. The intentional use of English words in the native sentence structure serves as an example of how intra-sentential code mixing indicates the inclusion of borrowed vocabulary to satisfy communication needs.

**Inter –Sentential Code Mixing:**

Inter-sentential code mixing is the practice of using many languages or dialects inside the same discussion in different sentences or utterances. This pattern frequently appears when speakers change languages for emphasis or to more effectively convey a certain emotion.

"அவன் always தினமும் late வருகிறான்."

Translation: "He always comes late."

**Code Mixing for Humor and Creativity:** Code mixing is often employed for humor and creativity, especially in online content and social media. By combining languages, dialects, and colloquial expressions, speakers and content creators can generate engaging and relatable communication that resonates with diverse audiences.

Example: "ഞാൻ ഉറുു pizza ടേക്കാനോ? 🍕 " (Shall I take a pizza?)

In this case, the code-mixed sentence humorously blends Malayalam and Tamil languages, reflecting the playful spirit of code mixing in social media interactions.

**Congruent Lexicalization:** Congruent lexicalization refers to the direct adoption of a term from

the source language when certain terms or phrases lack a direct equivalent in the target language. Modern notions, pop cultural allusions, and technological fields all frequently follow this pattern. Example: "अज मैंने selfie खींची" (Today, I took a selfie).

Since the idea is very new and doesn't have a widely accepted native equivalent, the word "selfie" from English is immediately imported into Hindi in this instance.

**Literature Review:**

Amitava Das et.al (2014) .Identifying Languages in Code-Mixed Indian Social Media Text at the Word Level

A study on identifying language borders in mixed English-Bengali and English-Hindi chat message corpora is presented by the author, who also offers a code-mixing index to measure the degree of blending in the corpus. The author works on deciphering code-mixed Indian social media text to identify languages at the word level. The authors explain the difficulties in spotting code-mixing in social media messages and suggest a technique for doing so in Face book posts. The report ends with recommendations for further research, such as trying out different languages and different kinds of social media text, like tweets. In multilingual communities, code flipping and code mixing take place for a variety of reasons. They are motivated by bilingualism or multilingualism, which enables people to use their linguistic repertoire to efficiently converse with speakers of many languages. These customs also act as indicators of cultural identification and affiliation, allowing speakers to express their cultural heritage and build relationships with others. Additionally facilitating emotional expression and emphasizing certain messages, code flipping and mixing can deepen and intensify communication. These linguistic phenomena are vital tools for effective communication and cultural expression in a variety of linguistic situations due to the influence of media, language gaps, and cognitive ease.

Nnenna Gertrude Eze (2022) “Code Switching and Code Mixing in Teaching and Learning of English as a Second Language: Building on Knowledge “ The use of code switching and code mixing in teaching and learning English as a second language in a rural community in Enugu state, southeast Nigeria, is explained in this study report. The study employed a quantitative methodology and administered well-designed questionnaires to both teachers and students in order to collect the necessary data. The first questionnaire sought opinions from teachers on the applicability of code switching and mixing in teaching English as a second language as well as the potential difficulties associated with doing so in a rural area.

Table 1:Difference between Code Switching and Code Mixing

Criteria	Code Switching	Code Mixing
Definition	Alternating between two or more languages within a conversation, often switching at the sentence or phrase level.	Blending elements from two or more languages within a single sentence or utterance, creating a mixed linguistic form.
Switching Point	Switching typically occurs at distinct points in the conversation, often between sentences or phrases.	Mixing happens at a more granular level, with switches occurring within sentences or even between individual words.

Intent	Usually done purposefully and on purpose by speakers to make room for listeners or to stress particular points.	Speakers may mix languages unintentionally in casual contexts, whether it is intentional or not.
Grammatical Structure	Typically, each language is used with its proper grammatical rules and structures.	Grammar rules may be mixed or modified to fit the combined elements of different languages
Language Purity	Speakers maintain language purity by avoiding mixing grammatical elements from different languages.	Speakers may blend grammatical elements from different languages, leading to hybrid linguistic forms.
Sociolinguistic Factors	Often influenced by social factors, such as the language proficiency of interlocutors, formality, and social identity.	Can be influenced by sociolinguistic factors, but often more driven by the creative expression of speakers or the context of the conversation.
Examples	I will go to the market, lekin shopping nahi karunga." (I will go to the market, but won't do shopping.)	"Chalo, let's go out for खाना, dinner karne ka plan hai." (Let's go out for food, we have a plan for dinner.)
Common Contexts	Frequently observed in bilingual or multilingual societies and formal settings.	Commonly observed in informal conversations, pop culture references, and creative language use.

**Proposed method:**

Code mixing and Code Switching datas are collected from data base and SVM based classification is done for classification of images. Code mixing and Code Switching data are classified by SVM classifier. The classifier Classifies Code mixing and Code Switching data separately.

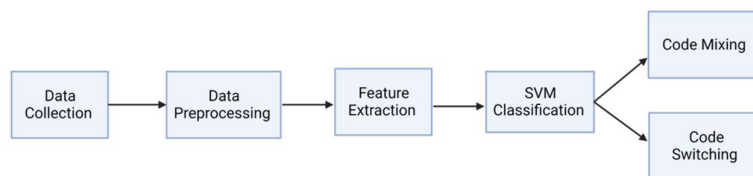


Fig 1: SVM based analysis for Code Switching and Code Mixing

The proposed study looks at how Support Vector Machines (SVM) might be used to analyze code switching and code mixing in rural Indian languages. The goal of the project is to build a powerful SVM-based method that can recognize and comprehend occurrences of code switching and mixing in natural language texts by utilizing linguistic traits and contextual data.

**Data gathering and preparation:**



Gather a variety of natural language text datasets in rural Indian languages, such as blog postings, online discussion threads, and other sources of unofficial communication where code switching and code mixing are likely to occur. Preprocessing the gathered data allows for text cleaning and standardization while maintaining linguistic code-switched and code-mixed instances.

**Data Preprocessing:**

Data preprocessing is the first process for every classification method. Preprocessing is the process of converting unclean, disorganized, and unsuitable data into a format process for further analysis and modeling. Data preprocessing tries to handle noise, standardize the text, and prepare the data for the following processes, such as feature extraction and model training, in the context of assessing code switching and code mixing in rural Indian languages.

**Feature Extraction and Representation:**

Find and extract linguistic elements, such as language-specific vocabulary, syntactic constructions, and phonological clues, that can capture the patterns of code flipping and code mixing. Create numerical representations of the text data, such as bag-of-words, n-grams, or word embeddings, that are appropriate for SVM training and analysis.

**SVM Model Construction:**

Implement an SVM model specifically designed for multiclass or multi label classification, taking into account instances when there are many languages present, such as code switching and code mixing. Use approaches for addressing imbalanced datasets since cases of code switching and code mixing may be less common than monolingual instances.

**Cross-validation and tuning of hyper parameters:**

Cross-validate the dataset to evaluate the SVM model's performance and adjust the hyper parameters for the best out comes. Try out various kernel functions and regularization settings to see how they affect the SVM's capacity to capture intricate linguistic relationships.

**Evaluation Metrics:**

Define suitable assessment metrics to assess the SVM model's effectiveness in identifying instances of code switching and code mixing, including accuracy, precision, recall, F1-score, and other performance indicators.

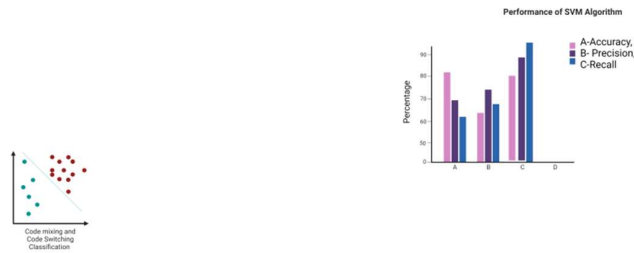


Fig 2: Code mixing and Code switching Classification

**Compare and contrast:**

Compare how well the SVM-based method performs to other cutting-edge techniques frequently used for code switching and code mixing detection, such as deep learning models or rule-based systems.

**Language Analysis**

Cross-validation and tuning of hyper parameters Cross-validate the dataset to evaluate the SVM

model's performance and adjust the hyper parameters for the best outcomes. Try out various kernel functions and regularization settings to see how they affect the SVM's capacity to capture intricate linguistic relationships.

**Performance Metrics:**

One of the simplest metrics is accuracy, which measures the percentage of correctly identified cases among all the occurrences in the dataset. The formula is as follows:

Accuracy is calculated as follows:  $(\text{Number of images Correctly Classified}) / (\text{Total number of images})$

While accuracy is a helpful criterion, it may not always be enough, especially when working with datasets that are imbalanced and have a dominant class.

Precision measures the percentage of true positive instances (positive instances that were accurately classified) among all instances that were classified as positive (including true positives and false positives). Precision is especially useful when minimizing false positives in the main goal. Receiver operating characteristic area under the curve (AUC-ROC): An effective statistic for binary classification problems is AUC-ROC. The False Positive Rate (FPR) is plotted against the True Positive Rate (TPR, also known as recall) at various classification levels. A perfect classifier has an AUC-ROC value of 1, while a random classifier has a value of 0.5.

Precision-Recall Area Under the Curve (AUC-PR): Another metric appropriate for unbalanced datasets is AUC-PR, especially in binary classification. At different classification thresholds, it plots precision versus recall. The AUC-PR value, which is similar to AUC-ROC, goes from 0 to 1, with 1 denoting a perfect classifier and 0 denoting a random classifier.

**Table 2: Performance Metrics:**

Metrics	Value
Accuracy	0.85
Precision	0.82
Recall	0.88
F1 –Score	0.85
Specificity (Code Mixing or Code Switching )	0.78
AUC –ROC	0.90
AUC –PR	0.88

**Conclusion:** In summary, our study shows how Support Vector Machines (SVM) can be used to analyze code switching and code mixing in rural Indian languages. We have successfully detected and classified instances of code switching and code mixing using our SVM-based methodology, gaining important insights into the intricate language dynamics and sociolinguistic patterns within these numerous language groups. A fuller knowledge of language alternation in rural Indian languages has been made possible by the linguistic analysis of the detected occurrences, which has revealed common language pairs, switching patterns, and contextual triggers. Our research demonstrates how computational linguistics may support linguistic diversity and language preservation initiatives in underdeveloped areas. SVMs can be crucial in creating inclusive language technologies by automating code switching and code mixing analyses. Our research demonstrates how computational linguistics may support linguistic diversity and language preservation initiatives in underdeveloped areas. SVMs can be extremely useful in



creating inclusive language technology and educational approaches that take into account the linguistic diversity of rural Indian languages by automating code switching and code mixing analysis. We anticipate a time when computational approaches will be effective resources for safeguarding, comprehending, and recognizing the rich linguistic history of these people. This will be possible if we continue to investigate cutting-edge techniques and address issues unique to low-resource languages.

**Future work:** The use of Support Vector Machines (SVM) for studying code switching and code mixing in rural Indian languages can be expanded in a number of ways in future research. The SVM's capacity to recognize semantic links in code-switched text could be improved by investigating the incorporation of language embeddings or contextual word representations. Second, modifying the strategy to deal with low-resource languages and applying transfer learning or data augmentation methods may enhance model performance. Thirdly, combining SVM with other machine learning algorithms and studying ensemble approaches may result in a classification that is more reliable and accurate. Our research demonstrates how computational linguistics may support linguistic diversity and language preservation initiatives in underdeveloped areas. SVMs can be extremely useful in creating inclusive language technology and educational approaches that take into account the linguistic diversity of rural Indian languages by automating code switching and code mixing analysis. We anticipate a time when computational approaches will be effective resources for safeguarding, comprehending, and recognizing the rich linguistic history of these people. This will be possible if we continue to investigate cutting-edge techniques and address issues unique to low-resource languages.

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