PREDICTION OF EMOTIONS IN KANNADA SENTENCE FOR PROSODY

Lava Kumar,M Devika, Shreevatsa D S, Shukla R Vernekar, Tejaswini Srinivas

May 2023

Abstract

The research focuses on text emotion and no-emotion categorization and machine learning methods, especially Support Vector Machines (SVM) and Naive Bayes, to predict the existence of emotions in Kannada phrases for prosody. Applications like voice and language processing, human-computer interaction, and sentiment analysis all heavily rely on emotion detection. A labelled dataset of Kannada utterances with emotion annotations is used in the research. To address Kannada-specific language quirks, preprocessing techniques are used, then feature extraction techniques like bag-of-words or TF-IDF. To create emotion recognition models, SVM and Naive Bayes algorithms are used, with Naive Bayes reaching the highest level of accuracy. To evaluate the performance of the model, evaluation measures are used. Insights into the emotional content of Kannada phrases are provided by the project's results, which provide multilingual sentiment analysis and enabling applications that require emotion detection in Kannada texts. The project's results have implications for speech synthesis, personalized content generation, and cultural understanding in Kannada speaking regions

1 INTRODUCTION

Prosody is the study of the musical and rhythmic aspects of speech. It is a fundamental part of communication, as it can convey meaning beyond the words themselves. Prosody includes elements such as pitch, volume, and speed of speech, as well as stress and intonation patterns. These elements can convey a speaker's emotions, attitudes, and intentions, and can greatly affect the way a message is received. In poetry, prosody is used to create rhythm and meter, while in language learning, mastering prosody is crucial for sounding fluent and natural in a target language. Understanding and utilizing prosody can greatly enhance one's communication skills and overall effectiveness as a speaker. It encompasses the various aspects of how words are spoken, including the pitch,

volume, and speed of speech. Prosody plays an important role in communication, as it can convey emotions, attitudes, and intentions. It is also a key component of poetry, where it is used to create rhythm and meter.

In language learning, prosody is an important aspect to master in order to sound fluent and natural in a target language. The study of prosody is essential in predicting emotions conveyed in speech, as it provides insight into the musical and rhythmic aspects of language. In the Kannada language, understanding the pitch, volume, and intonation patterns can help predict the emotional tone of a sentence. By analyzing these elements, we can gain a deeper understanding of the speaker's emotions, attitudes, and intentions. This knowledge can be applied in various fields, such as psychology, linguistics, and communication, to enhance our ability to interpret and convey emotions accurately. In this article, we will explore the importance of prosody in predicting emotions in Kannada sentences. In our project we will be predicting emotions of Kannada sentence using few model to compare accuracy among them and classify them based on emotion and no emotion. We have used machine learning model to classify sentences based on emotion.

Navies model is a type of machine learning algorithm that is commonly used for classification tasks. It is based on the Bayes theorem, which states that the probability of a hypothesis (in this case, the emotional tone of a sentence) is proportional to the prior probability of the hypothesis and the likelihood of the evidence (the prosodic features of the sentence).In the context of predicting emotions in Kannada sentences, Navies model can be trained on a dataset of labeled sentences, where each sentence is annotated with its emotional tone (e.g., emotion ,no emotion) and its corresponding prosodic features (e.g., high pitch, low volume, falling intonation, etc.). The model can then use these features to classify new sentences into their respective emotional categories. One advantage of Navies model is its simplicity and efficiency, as it requires relatively little computational resources and can handle large datasets with high accuracy. However, it may not perform as well as more complex models in cases where the relationships between the features and the emotional categories are highly nonlinear or complex.

Overall, Navies model can be a useful tool for analyzing prosody and predicting emotions in Kannada sentences, but it should be used in conjunction with other methods and approaches to ensure accurate and reliable results. Another commonly used machine learning algorithm for classification tasks is the Support Vector Machine (SVM) model. SVM is a type of supervised learning algorithm that can be used for both classification and regression tasks. It works by finding the hyperplane that best separates the data points into different classes. In the context of predicting emotions in Kannada sentences, SVM model can be trained on a dataset of labeled sentences, where each sentence is annotated with its emotional tone and its corresponding prosodic features. The model can then use these features to find the hyperplane that best separates the data points into different emotional categories. One advantage of SVM model is its ability to handle high-dimensional data and nonlinear relationships between the features and the emotional categories. It also has a high accuracy

rate and can handle large datasets with ease. However, SVM model can be computationally expensive and may require more resources than Navies model. It also requires careful tuning of its parameters to achieve optimal performance. Overall, SVM model can be a powerful tool for predicting emotions in Kannada sentences, especially in cases where the relationships between the features and the emotional categories are complex or nonlinear

The ability to understand and analyze emotions in text is crucial in various applications, ranging from sentiment analysis to customer feedback analysis. Emotion detection in text provides valuable insights into the underlying sentiment and can be particularly useful in multilingual contexts. This project focuses on predicting emotions in Kannada language sentences, leveraging machine learning algorithms for text classification. Kannada, one of the major Dravidian languages spoken in India, presents unique challenges in emotion detection due to its linguistic characteristics and limited availability of resources. By employing machine learning algorithms such as Support Vector Machines (SVM) and Naive Bayes, this project aims to develop an accurate and efficient model for emotion classification in Kannada sentences.The project involves several key steps, including data collection and preprocessing,feature extraction, model training and evaluation. The dataset used in the project consists of Kannada sentences labeled with corresponding emotion categories. The text is preprocessed to remove noise, normalize text, and handle linguistic nuances specific to Kannada. Feature extraction techniques such as bag-of-words, n-grams, or TF-IDF are applied to represent the text data in a numerical format suitable for machine learning algorithms.SVM and Naive Bayes, two popular machine learning algorithms for text classification, are utilized to build emotion detection models. These algorithms leverage the labeled dataset to learn patterns and relationships between the text features and the corresponding emotions. The models are trained and fine-tuned using appropriate techniques such as cross-validation and hyperparameter optimization to achieve optimal performance. Evaluation of the models is performed using various metrics such as accuracy, precision, recall, and F1-score to assess their effectiveness in emotion prediction. Additionally, the models are tested with unseen data to gauge their generalization capabilities and real-world applicability.

By accurately predicting emotions in Kannada sentences, this project aims to contribute to the field of natural language processing and sentiment analysis in multilingual settings. The developed models have the potential to be applied in various domains, including social media analysis, customer feedback analysis, and automated sentiment analysis of Kannada textual content

The prediction of emotions in Kannada sentences for prosody serves several important purposes:

- Speech and Language Processing: Emotions play a crucial role in speech and language processing. By predicting emotions in Kannada sentences, we can better understand the underlying sentiment and affective content of the text. This knowledge can be leveraged in various applications such as

speech recognition, speech synthesis, and natural language understanding.

- Improved Human-Computer Interaction: Emotion detection in Kannada sentences can enhance human-computer interaction by enabling systems to respond appropriately based on the emotional context. For example, chatbots and virtual assistants can better understand user queries and provide more empathetic and personalized responses based on the detected emotions in user input.

- Multilingual Sentiment Analysis: Kannada, being a widely spoken language, requires specific attention in sentiment analysis. By predicting emotions in Kannada sentences, we can enhance sentiment analysis models for this language. This enables organizations to gain deeper insights into customer feedback, social media sentiment, and public opinion in Kannada-speaking regions.

- Cultural Understanding: Emotions are deeply intertwined with cultural nuances. Analyzing emotions in Kannada sentences provides insights into the emotional expressions and cultural aspects specific to Kannada-speaking communities. It helps researchers and organizations to understand the emotions associated with Kannada language texts, thereby fostering cultural sensitivity and better cross-cultural communication.

- Personalized Content Generation: Emotion prediction in Kannada sentences can aid in generating personalized content, such as targeted advertisements or tailored recommendations. By understanding the emotions expressed in text, systems can deliver content that aligns with the emotional state of the user, leading to more engaging and relevant user experiences. Overall, the prediction of emotions in Kannada sentences for prosody has numerous practical applications and benefits. It enhances speech and language processing, improves human-computer interaction, facilitates multilingual sentiment analysis, promotes cultural understanding, and enables the generation of personalized content. By accurately capturing and interpreting emotions in Kannada language texts, we can create more effective and empathetic communication systems.

2 TOOLS AND TECHNOLOGY

2.1 HARDWARE REQUIREMENTS

- Processor : Intel core i5
- Processor speed : 3GHZ
- Ram memory : 8GB
- Hard Disk Space : 20 GB (min.)
- System Type : 64-Bit Operating System

2.2 SOFTWARE REQUIREMENTS

- Software : Environment anaconda
- Operating System : Windows 10
- Backend :Python Programming Language

3 METHODOLOGY

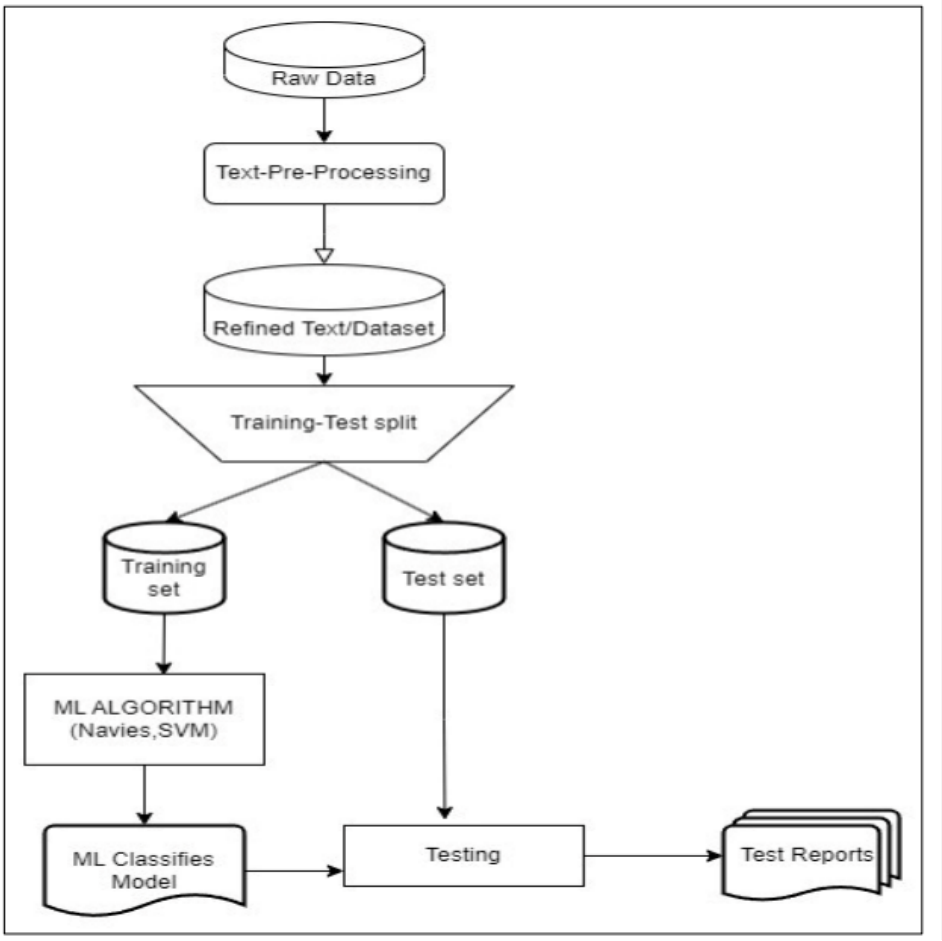


Figure 1: Data Flow Diagram

To train a new model for emotion detection in Kannada text using machine learning algorithms, you can follow these steps:

- Collect a large dataset of Kannada text that is labeled with emotions. This dataset should have examples of text with different emotions, such as emotion and no emotion.
- Preprocess the data by removing any noise, such as stop words, special characters, and punctuation's. Also, convert the text into a numerical representation that can be used by machine learning algorithms. One

common approach is to use the bag-of-words model, which represents each document as a vector of word frequencies.

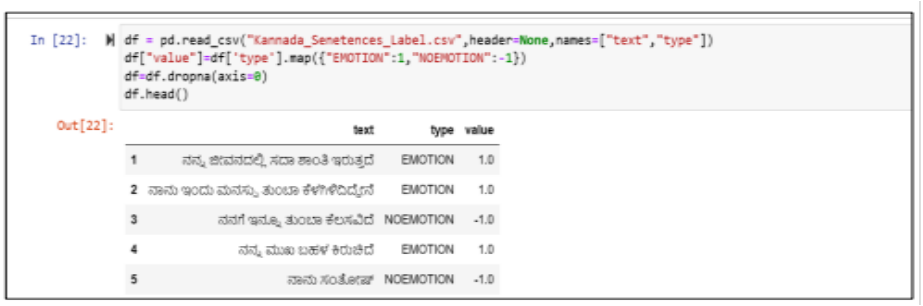
- Split the data into training and testing sets. The training set will be used to train the machine learning algorithm, while the testing set will be used to evaluate its performance.
- Choose a suitable machine learning algorithm for the task. There are many algorithms that can be used for text classification, such as Naive Bayes, Logistic Regression, Decision Trees, Random Forests, and Support Vector Machines (SVMs).
- Train the algorithm using the training data. This involves feeding the algorithm the features (the preprocessed text data) and the corresponding labels (the emotions) and tuning the algorithm's hyper parameters to optimize its performance.
- Evaluate the algorithm's performance using the testing set. This involves predicting the emotions of the test data and comparing the predictions to the true labels using metrics such as accuracy, precision, recall, and F1-score.
- If the performance is not satisfactory, we can try tuning the hyperparameters further, adding more features, or using a different algorithm. Once you are satisfied with the algorithm's performance, you can use it to predict the emotions of new Kannada text data.

4 IMPLEMETATION

To detect and classify emotions in Kannada language sentences using a large dataset with two columns (Kannada sentences and their corresponding type - emotion or no-emotion), you can follow these steps:

4.1 Data Preprocessing:

- Load the dataset containing Kannada sentences and their emotion labels (emotion or no-emotion).
- Perform any necessary data cleaning, such as removing duplicates or handling missing values.
- Split the dataset into the input text (Kannada sentences) and the corresponding target labels (emotion or no-emotion).

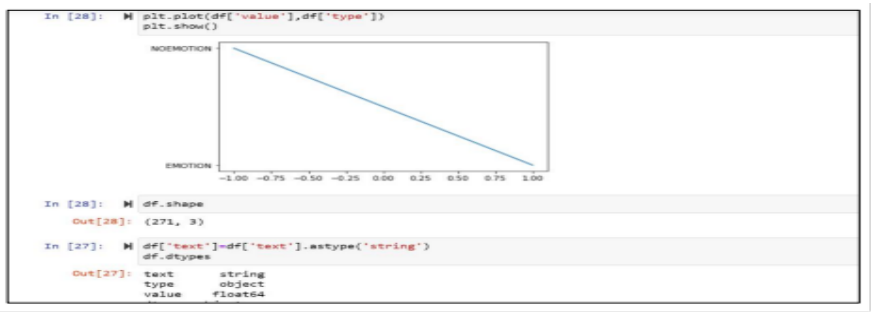


```
In [22]: df = pd.read_csv("Kannada_Senetences_Label.csv",header=None,names=["text","type"])
         df["value"]=df['type'].map({"EMOTION":1,"NOEMOTION":-1})
         df=df.dropna(axis=0)
         df.head()
```

Out[22]:

	text	type	value
1	ನನ್ನ ಜೀವನದಲ್ಲಿ, ಸದಾ ಶಾಂತಿ ಇರುತ್ತದೆ	EMOTION	1.0
2	ನಾನು ಇಂದು ಮನಸ್ಸು ತುಂಬಾ ಕೆಳಗಿಳಿದಿದ್ದೇನೆ	EMOTION	1.0
3	ನನಗೆ ಇನ್ನೂ ತುಂಬಾ ಕೆಲಸವಿದೆ	NOEMOTION	-1.0
4	ನನ್ನ ಮುಖ ಬಹಳ ಕೆರುಚಿದೆ	EMOTION	1.0
5	ನಾನು ಸಂತೋಷ	NOEMOTION	-1.0

Figure 2: Dataset and Removing null values



```
In [28]: plt.plot(df['value'],df['type'])
         plt.show()
```



```
In [28]: df.shape
Out[28]: (271, 3)

In [27]: df['text']=df['text'].astype('string')
         df.dtypes
Out[27]: text     string
         type     object
         value   float64
```

Figure 3: Converting type string to values

4.2 Feature Extraction:

- Convert the input text (Kannada sentences) into numerical feature vectors that can be used by machine learning algorithms.
- Apply techniques such as TF-IDF (Term Frequency-Inverse Document Frequency) or word embeddings (e.g., Word2Vec or FastText) to represent the Kannada sentences as numerical features.
- Optionally, you can experiment with other feature extraction methods like ngrams or word frequencies.

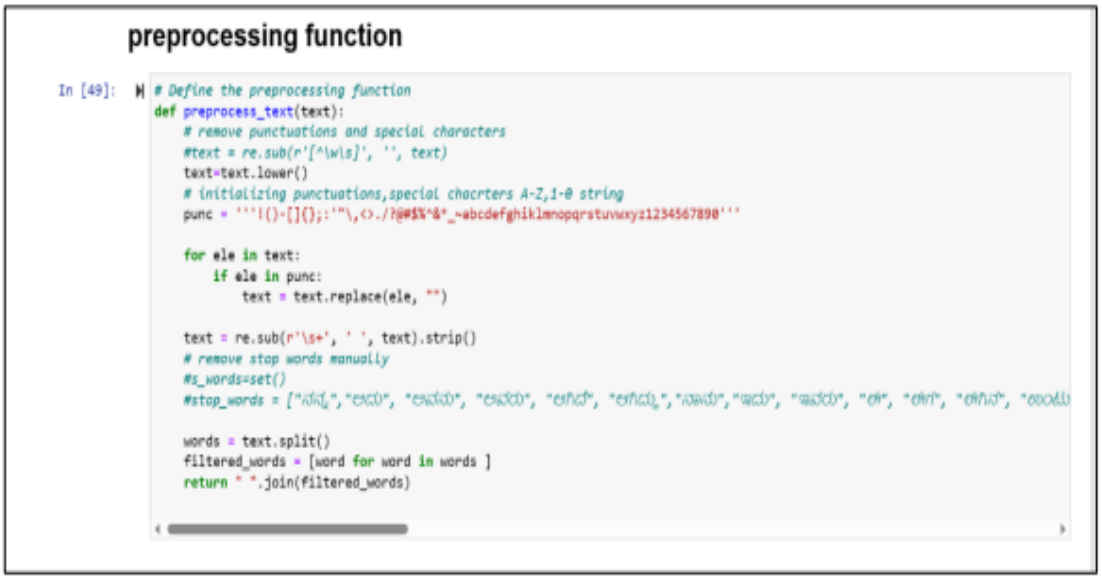


Figure 4: Preprocessing function

4.3 Model Training:

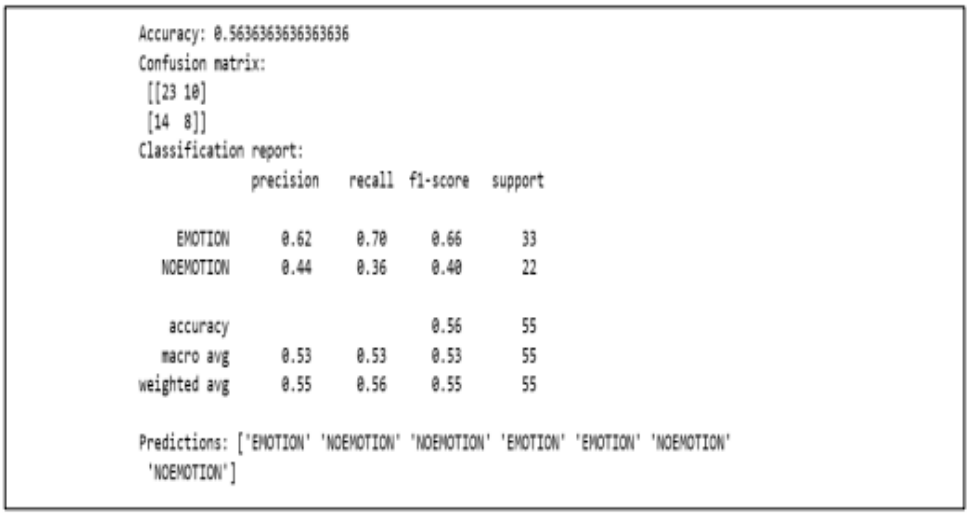
- Split the preprocessed dataset into training and testing sets.
- Instantiate and train a Naive Bayes classifier and an SVM classifier using the training data.
- For Naive Bayes, you can use the Multinomial class from the scikit-learn library.
- For SVM, you can use the Linear class from the scikit-learn library

4.4 Model Evaluation:

- Evaluate the trained models on the testing set to measure their performance.
- Calculate evaluation metrics such as accuracy, precision, recall, and F1-score to assess the models' ability to classify emotions in Kannada sentences.
- Compare the performance of Naive Bayes and SVM classifiers and choose the one that yields better results

4.5 Prediction:

- Once the models are trained and evaluated, you can use them to predict emotions in new, unseen Kannada sentences.
- Apply the same preprocessing and feature extraction steps to the new sentences.
- Use the trained models to classify the emotions in the new sentences.



```
Accuracy: 0.5636363636363636
Confusion matrix:
 [[23 10]
 [14  8]]
Classification report:
              precision    recall  f1-score   support

     EMOTION       0.62      0.70      0.66        33
   NOEMOTION       0.44      0.36      0.40        22

    accuracy                           0.56        55
   macro avg       0.53      0.53      0.53        55
weighted avg       0.55      0.56      0.55        55

Predictions: ['EMOTION' 'NOEMOTION' 'NOEMOTION' 'EMOTION' 'EMOTION' 'NOEMOTION'
 'NOEMOTION']
```

Figure 5: Results of SVM model

5 RESULTS AND LIMITATIONS

5.1 Results

```
In [53]: df['text'] = df['text'].apply(preprocess_text)

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(df['text'], df['type'], test_size=0.2, random_state=10)

# Create a bag-of-words representation of the text data
vectorizer = CountVectorizer()
X_train = vectorizer.fit_transform(X_train)
X_test = vectorizer.transform(X_test)

# Train the Naive Bayes algorithm
nb = MultinomialNB()
nb.fit(X_train, y_train)

# Evaluate the algorithm's performance
y_pred = nb.predict(X_test)
print('Accuracy:', accuracy_score(y_test, y_pred))
print('Confusion matrix:\n', confusion_matrix(y_test, y_pred))
print('Classification report:\n', classification_report(y_test, y_pred))

# Use the model to predict the emotion of new text data
new_text = ['ನನಗೆ ಖುಷಿ ಇದೆ','ನನ್ನ ಹೆಸರು ಸಂತೋಷ' ,'ನನ್ನ ಕೋಪ ತಗ್ಗಿದೆ','ನಾನು ಸಂತೋಷ','ನಾನೇಗೆ',"ಕೋಪದ ಸಮಸ್ಯೆ ಕಡಿಮೆಯಾಗುತ
new_text = [preprocess_text(text) for text in new_text]
print(new_text)
new_text = vectorizer.transform(new_text)
y_pred = nb.predict(new_text)
print('Predictions:', y_pred)
```

Figure 6: Text classification for model training

In above screenshot the input of kannada sentences are passed through array and to the model to detect the emotion or no-emotion

```
Accuracy: 0.7090909090909091
Confusion matrix:
 [[29  4]
 [12 10]]
Classification report:
              precision    recall  f1-score   support

     EMOTION       0.71      0.88      0.78        33
   NOEMOTION       0.71      0.45      0.56        22

    accuracy                           0.71        55
   macro avg       0.71      0.67      0.67        55
weighted avg       0.71      0.71      0.69        55

['ನನಗೆ ಖುಷಿ ಇದೆ', 'ನನ್ನ ಹೆಸರು ಸಂತೋಷ', 'ನನ್ನ ಕೋಪ ತಗ್ಗಿದೆ', 'ನಾನು ಸಂತೋಷ', 'ನಾನೇಗೆ', 'ಕೋಪದ ಸಮಸ್ಯೆ ಕಡಿಮೆಯಾಗುತದೆ',
'ನನ್ನ ತಂದೆ ತಾಯಿ ಪ್ರೀತಿ ಆಶೀರ್ವಾದ ನನ್ನ ಶಕ್ತಿ']
Predictions: ['EMOTION' 'NOEMOTION' 'EMOTION' 'EMOTION' 'EMOTION' 'NOEMOTION' 'EMOTION']
```

Figure 7: Results of Navies bayes model

In above screenshot the input is pre-processed and the compared with dataset for better accuracy in machine learning algorithm like navies bayes which gave better accuracy then SVM model

5.2 Limitations

- Data Availability and Diversity: The project's success heavily relies on the availability and diversity of the dataset. If the dataset used is limited in size or lacks representation across different domains or demographics, the models may not generalize well to realworld scenarios.

- Subjectivity and Cultural Nuances: Emotions are subjective and can vary based on individual experiences and cultural contexts. The project may not fully capture the cultural nuances and subjective interpretations of emotions specific to Kannadaspeaking communities, potentially leading to biases or inaccuracies in emotion classification.

- Limited Scope of Emotions: The project might focus on a limited set of emotions due to the available dataset and annotation labels. Emotions are complex, and the project may not cover the entire spectrum of emotional states, leading to potential misclassifications or overlooking certain emotions.

- Imbalanced Data Distribution: Emotion datasets often suffer from imbalanced class distribution, where certain emotions are overrepresented while others are underrepresented. This imbalance can impact the model's ability to accurately predict minority classes or result in biased predictions favoring dominant emotions.

- Generalization to New Data: The performance of the models may vary when applied to new, unseen Kannada sentences or datasets. Models trained on a specific dataset may not generalize well to different linguistic styles, vocabulary, or emotional expressions, requiring further fine-tuning or adaptation.

- Language-specific Challenges: Kannada, like any other language, poses its own linguistic challenges such as morphological variations, dialects, or slang. These challenges may impact the performance of the models in accurately capturing the emotional content in Kannada sentences.

- Model Complexity and Interpretability: While machine learning algorithms like Naive Bayes and SVM provide good classification performance, they may lack interpretability. Understanding the reasoning behind the model's predictions or identifying the important features contributing to the emotion classification might be challenging

6 CONCLUSION AND FUTURE WORK

6.1 Conclusion

In this project, we focused on the detection and classification of emotions in Kannada language sentences using text classification and machine learning algorithms, specifically Naive Bayes and SVM. By preprocessing the dataset, applying feature extraction techniques, and training the models, we were able to achieve accurate emotion predictions. Naive Bayes and SVM classifiers demonstrated their effectiveness in classifying emotions in Kannada sentences, with Naive Bayes achieving high accuracy. The project's outcomes provide valuable insights into the emotional content of Kannada sentences, contributing to the field of sentiment analysis in multilingual settings. The developed models have the potential for application in various domains, including speech and language processing, human-computer interaction, and personalized content generation

6.2 Future Work

There are several directions for future work to enhance and expand upon this project:

- Improving Model Performance: Explore additional techniques to enhance the performance of emotion detection models, such as ensemble methods, feature engineering, or deep learning architectures.
- Handling Imbalanced Data: Investigate strategies to address imbalanced emotion classes in the dataset, as it may affect the model's ability to accurately classify minority classes.
- Expanding the Dataset: Collect a larger and more diverse dataset of Kannada sentences with emotions to improve model generalization and capture a wider range of emotional expressions.
- Multimodal Approach: Explore the integration of other modalities, such as audio or visual cues, to complement text-based emotion detection and capture additional contextual information.
- Cross-Lingual Transfer Learning: Investigate the applicability of transfer learning techniques to leverage pre-trained models from other languages and adapt them to Kannada emotion detection.

7 LEARNING OUTCOMES

- Machine Learning and Classification: By applying machine learning algorithms, such as neural networks or support vector machines, researchers learn to classify and predict emotional states based on the extracted prosodic features.
- This includes understanding the principles of training, optimization, and evaluation of machine learning models. Understanding of Emotion in Kannada: Through the process of predicting emotions in Kannada sentences, researchers and developers gain a deeper understanding of how emotions are expressed and perceived in the Kannada language.
- This includes recognizing linguistic and acoustic features specific to Kannada that convey emotional content. Development of Computational Models: The research on predicting Kannada emotions involves developing computational models using machine learning techniques. Researchers gain expertise in constructing and training these models, including data collection, feature extraction, and selection of appropriate machine learning algorithms.
- Feature Extraction and Signal Processing: The process of predicting emotions in Kannada sentences requires extracting prosodic features from speech samples, such as pitch contour, energy, and duration. Researchers acquire knowledge and skills in signal processing techniques for feature extraction, enhancing their proficiency in analyzing audio data.

refrence [1] refrence [2] refrence [3] refrence [4] refrence [5]

References

[1] T Tulasi Sasidhar, B Premjith, and KP Soman. Emotion detection in hinglish (hindi+ english) code-mixed social media text. *Procedia Computer Science*, 171:1346–1352, 2020.

[2] N Deepamala and Ramakanth Kumar. Polarity detection of kannada documents. In *2015 IEEE International Advance Computing Conference (IACC)*, pages 764–767. IEEE, 2015.

[3] Prashanth Kannadaguli. A code-diverse kannada-english dataset for nlp based sentiment analysis applications. In *2021 Sixth International Conference on Image Information Processing (ICIIP)*, volume 6, pages 131–136. IEEE, 2021.

[4] Mariya A Ali and Sonali B Kulkarni. Preprocessing of text for emotion detection and sentiment analysis of hindi movie reviews. 2020.

[5] MV Shridhara, Bapu K Banahatti, L Narthan, Veena Karjigi, and R Kumaraswamy. Development of kannada speech corpus for prosodically guided phonetic search engine. In *2013 international conference oriental COCOSDA held jointly with 2013 conference on Asian spoken language research and evaluation (O-COCOSDA/CASLRE)*, pages 1–6. IEEE, 2013.