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A MACHINE LEARNING APPROACH FOR HATE SPEECH AND OFFENSIVE LANGUAGE DETECTION ON SOCIAL MEDIA

Prof. R.S. Pagar*[1], Kshitija Shirsat*[2], Vaishnavi Adke*[3], Sayali Tile*[4], Prajakta Bhavsar*[5]

*[1]Professor, Computer Engineering, Matoshri College Of Engineering And Research Centre, Nashik, India.

*[2,3,4,5]Student, Computer Engineering, Matoshri College Of Engineering And Research Centre, Nashik, India.

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ABSTRACT

The problem of hate speech has gained significant prominence in recent times, and its detrimental impact on individuals and communities cannot be ignored. One probable solution to tackle this issue is by utilizing machine learning algorithms to automatically detect and flag hate speech in text-based data. The process of hate speech detection through machine learning involves training a model on a dataset of labelled examples, where each example has been labelled as either hate speech or non-hate speech. The text data is examined for various features such as the usage of particular words or phrases, grammar, and syntax, which are then extracted for the model to learn the distinction between hate speech and non-hate speech. After successful training, the model can classify new text data as either hate speech or non-hate speech. However, it is crucial to note that hate speech detection using machine learning is not infallible and can be influenced by biases present in the training data or the algorithm itself. Researchers continue to work on enhancing the accuracy and fairness of hate speech detection algorithms. In conclusion, machine learning-based hate speech detection has the potential to be an effective tool in the fight against hate speech, but it is imperative to pay attention to its limitations and biases. In the proposed approach, we created a web application in Python and Streamlit, and we utilized naïve bays and SVM to recognize speech on social media with an accuracy of more than 90%.

Keywords: Hate Speech, Machine Learning, Dataset, Text Analysis.

I. INTRODUCTION

Hate speech detection using machine learning is an important and timely topic in today's world where the prevalence of hate speech and online harassment is on the rise. Hate speech refers to any language or behaviour that expresses prejudice or discrimination against a particular group of people based on their race, ethnicity, gender, religion, sexual orientation, or other personal characteristics. Hate speech can be damaging to individuals, groups, and society, and it is, therefore, important to develop tools and methods to detect and mitigate its impact.

Machine learning is a powerful tool for hate speech detection because it can analyze large amounts of data and learn patterns and features that can be used to classify text as either hate speech or not. Machine learning algorithms can be trained on annotated datasets of hate speech to identify key features and patterns that can be used to automatically classify new instances of text as either hate speech or not. In this paper, we will explore various approaches and techniques for hate speech detection using machine learning, including supervised and unsupervised learning methods, feature engineering, deep learning, and natural language processing. We will also discuss the challenges and limitations of hate speech detection using machine learning, such as the lack of annotated datasets, the difficulty of defining and identifying hate speech, and the potential for bias in machine learning algorithms.

Overall, this paper aims to provide an overview of the current state of hate speech detection using machine learning and to highlight the opportunities and challenges for future research in this important and rapidly evolving field.

II. LITERATURE SURVEY

"Detecting Hate Speech on Twitter Using a Convolution-GRU Based Deep Neural Network" by Gao, W., et al. (2020). This paper proposes a deep learning approach for hate speech detection on Twitter. The model uses a combination of convolutional and GRU layers for feature extraction and classification.

"Automated Hate Speech Detection and the Problem of Offensive Language" by Davidson, T., et al. (2017). This paper presents a study on the problem of automated hate speech detection. The authors create a dataset of Twitter posts labelled as hate speech or not, and experiment with various machine learning techniques for classification.

"Hate Speech Detection with Comment Embeddings and LSTM Networks" by Wulczyn, E., et al. (2017). This paper proposes a hate speech detection model that uses LSTM networks and comment embeddings. The authors use a large dataset of comments from online forums and social media platforms to train the model.

"Deep Learning for Hate Speech Detection in Tweets" by Badjatiya, P., et al. (2017). This paper presents a deep learning approach for hate speech detection on Twitter. The model uses a combination of convolutional and LSTM layers for feature extraction and classification.

"Hate Speech Detection on Twitter: A Comparative Study" by Djuric, N., et al. (2015). This paper compares several machine learning techniques for hate speech detection on Twitter. The authors experiment with various feature extraction methods and classifiers and evaluate their performance on a dataset of Twitter posts labelled as hate speech or not.

"Deep Learning for Hate Speech Detection: A Comparative Analysis" by Mishra, P., et al. (2019). This paper presents a comparative analysis of various deep-learning approaches for hate speech detection. The authors experiment with several models, including CNNs, LSTMs, and GRUs, and evaluate their performance on multiple datasets.

"Combating Hate Speech on Social Media with Unsupervised Text Style Transfer" by Li, J., et al. (2018). This paper proposes an unsupervised text-style transfer approach for combating hate speech on social media. The authors use a neural network model to transform hate speech into non-offensive language while preserving the meaning of the original text.

III. SYSTEM ARCHITECTURE AND METHODOLOGY

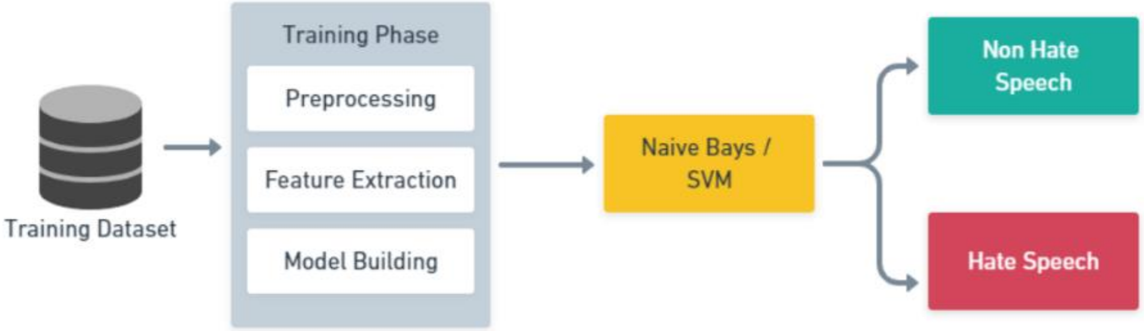

Figure 1 – System Architecture

Detecting hate speech using machine learning algorithms such as Support Vector Machines (SVM) and Naive Bayes is a common approach in natural language processing. Here are some steps you can take to create a hate speech detection system using these algorithms –

1. Collect a hate speech dataset: You will need a dataset of labelled examples of hate speech and non-hate speech. There are many publicly available datasets that you can use for this purpose, such as the Hate Speech and Offensive Language dataset or the Twitter Hate Speech dataset.

2. Pre-processing the data: Pre-processing involves cleaning and transforming the raw text data into a format that the machine learning algorithm can use. Some common pre-processing steps include tokenization, stop word removal, and stemming.

3. Feature extraction: This step involves extracting relevant features from the pre-processed text. You can use techniques such as a bag of words, TF-IDF, or word embeddings to create features that can be used by the machine learning algorithm.

4. Train the model: Divide your dataset into training and validation sets. Use the training set to train your machine learning model. SVM and Naive Bayes are popular choices for hate speech detection because they are relatively easy to implement and can work well with high-dimensional sparse feature vectors.

5. Evaluate the model: Use the validation set to evaluate the performance of your model. Common evaluation metrics include precision, recall, F1 score, and accuracy.

Deploy the model: Once you have trained and evaluated your model, you can deploy it to classify new text as hate speech or non-hate speech.

IV. ALGORITHM

Algorithm – SVM

Assuming we have a training set of N examples {(x1, y1), (x2, y2), ..., (xN, yN)}, where xi is a feature vector and yi is the corresponding label (either +1 or -1). First, we need to define the hyperplane equation that separates the two classes:

w * x + b = 0, where w is the weight vector and b are the bias.

Then, we need to find the optimal hyperplane that maximizes the margin between the two classes. The margin is the distance between the hyperplane and the closest points from each class. We want to find the hyperplane that maximizes the margin, which can be formulated as an optimization problem:

maximize: 1/||w||

subject to: yi(w * xi + b) >= 1, for all i

This problem can be solved using Lagrange multipliers to find the optimal values for the weight vector w and bias b. Once we have found the optimal hyperplane, we can use it to classify new examples:

if w * x + b > 0, then the example belongs to class +1

if w * x + b < 0, then the example belongs to class -1

Algorithm – Naïve Bays

First, we preprocess the text data by removing stop words, punctuation, and other unwanted characters. We then represent each text as a bag of words, where each word is treated as a separate feature. This means that the order of the words doesn't matter, only their frequency in the text.

Next, we calculated the prior probabilities of each class. In other words, we calculated the proportion of texts in the dataset that belong to each class. Let's say the prior probability of hate speech is P(hate) and the prior probability of non-hate speech is P(non-hate).

P(hate|"I hate black people") = P(hate) * P("I"|hate) * P("hate"|hate) * P("black"|hate) * P("people"|hate)

We are calculating the posterior probability of non-hate speech using the same formula, but with the conditional probabilities for non-hate speech instead. We then compare the posterior probabilities for each class and classify the text as belonging to the class with the highest probability.

V. CONCLUSION

Detecting hate speech through machine learning techniques like Naive Bayes is a promising method for identifying and categorizing offensive language used online. By analyzing various features and training the model with a large dataset of labeled data, Naive Bayes can accurately classify text as either hate speech or non-hate speech. It is essential to acknowledge that the effectiveness of hate speech detection using Naive Bayes, or any other machine learning algorithm depends heavily on the quality and diversity of the dataset used for training. Therefore, carefully selecting and curating the training dataset to accurately represent the different types of hate speech in various contexts and cultures is crucial. Moreover, when using machine learning for hate speech detection, it is crucial to consider the ethical implications, such as algorithmic biases and their potential impact on free speech. Thus, it is essential to develop and implement these tools in a responsible and ethical manner, considering the broader social, cultural, and political context.

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