SMS SPAM DETECTION USING MACHINE LEARNING

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Abstract. An efficient SMS spam detection system is developed using the Multinomial Naive Bayes (MNB) algorithm. It employs a labeled dataset and extracts features with the term frequency-inverse document frequency (TF- IDF) method. The MNB algorithm classifies messages by modeling term probability distributions. Parameter tuning and pre-processing techniques like text normalization and stop-word removal enhance feature quality. Experimental results show high accuracy, precision, recall, and F1-score, making MNB suitable for real-time applications. The system provides a practical solution for SMS spam detection and enhances mobile communication security.

Keywords. SMS, Multinomial Naïve Bayes, Mobile Communication Security.

1. INTRODUCTION

This project addresses the increasing issue of spam SMS, which poses risks like phishing, fraud, and data theft. Scammers frequently adapt their methods, making traditional spam detection techniques ineffective. The project proposes developing an advanced machine learning model to classify and detect spam messages accurately, providing better protection to users. The model leverages algorithms such as Naïve Bayes and TF-IDF vectorizer for initial detection but plans to enhance accuracy by incorporating Random Forest and Support Vector Machine (SVM). The aim is to improve performance by using larger datasets and more robust preprocessing techniques. Additionally, this solution could be integrated into an app, offering users real-time spam detection. The ultimate goal is to provide a safer digital environment by reducing exposure to harmful messages.

2. LITERATURE SURVEY

2.1 Sefat E Rahman and Shofi Ullah (2020)

In this model, I tackle the issue by addressing email spam detection by combining sentiment analysis, Word Embeddings, and a Bidirectional LSTM network to analyze both sentiment and sequence in email body text. A Convolutional Neural Network enhances training and feature extraction. Tested on datasets like lingspam, the model achieves 98-99% accuracy, outperforming traditional classifiers and state-of-the-art methods, demonstrating its efficiency in combating spam challenges.

2.2 Haiying Shen and Ze Li (2013)

In this model, I tackle the challenge of rising unsolicited emails by introducing a new spam filter approach. I point out the limitations of traditional static filters and emphasize the adaptability of Bayesian filters, which continuously learn from new spam. However, Bayesian filters face challenges like susceptibility to clever spammers and slow adaptation. Recognizing the underutilization of social networks in current filters, I propose the Social network Aided Personalized and effective spam filter (SOAP). SOAP uses a distributed overlay through social network links, with each node autonomously checking spam, departing from traditional centralized methods. SOAP focuses on social relationships and interests for adaptive spam detection, introducing four key components: social closeness-based filtering, interest-based filtering, adaptive trust management, and friend notification. Through performance evaluations, SOAP shows significant improvement in Bayesian spam filter accuracy, attack-resilience, and efficiency, setting a new standard in spam detection.

2.3 A Machine Learning based spam detection mechanism(2020)

In this model, I address the common issue of receiving spam emails in today's internet-centric data environment, where such emails are often commercial or may even contain phishing links with malware. Recognizing the importance of detecting and identifying these spam emails to save system time and memory space, I propose a prudent mechanism. Our presented algorithm focuses on filtering both spam and non-spam emails by generating a dictionary and features, which are then trained through machine learning for effective results. This approach aims to enhance email security and optimize system resources efficiently.

2.4 Analysis of Optimized Machine Learning and Deep Learning Techniques for Spam Detection (2021)

In this model, I address the common issue of email spam detection using DBSCAN, Isolation Forest, and feature selection techniques like Heatmap and Chi-Square. Combining machine learning and deep learning, it incorporates ensemble methods like Multinomial Naïve Bayes, Random Forest, KNN, Gradient Boosting, RNN, and ANN. Comparative analysis shows outstanding performance, with 100% accuracy and 0 errors in machine learning, and 99% accuracy with a loss of 0.0165 in deep learning, based on a UCI dataset, demonstrating its effectiveness in identifying spam emails.

3. SYSTEM DESIGN

The SMS spam detection system leverages a Multinomial Naive Bayes (MNB) classifier, focusing on classifying SMS messages into spam or non-spam. The process involves data collection, preprocessing (cleaning, tokenization, normalization), and feature extraction through term frequency-inverse document frequency (TF-IDF). The MNB model is trained and evaluated on labeled datasets to improve accuracy, achieving high performance in real-time applications.

3.1 Backend Architecture

The backend is developed using Python for data preprocessing, TF-IDF feature extraction, and training a

Multinomial Naive Bayes model for spam detection. The backend is responsible for managing all core functionalities, including:

Data Processing: Collects SMS messages from datasets, cleans, tokenizes, and applies TF-IDF for feature extraction.

Model Training: Utilizes Multinomial Naive Bayes, calculating probabilities for spam classification based on word frequencies.

Evaluation and Deployment: Evaluates using metrics like accuracy and precision; integrates the model into a production environment for live spam detection.

3.2 Frontend Architecture

The frontend of the platform is built with Streamlit to create a web interface, enabling users to input messages and view spam detection results in real-time.key features include:

User Interface: A web-based interface built using Streamlit, allowing users to input messages for spam prediction.

Display and Interaction: Upon message input, displays classification results (spam or not spam), offering a user-friendly experience for real-time spam detection.

3.3 Security

Protection of User Privacy: The model protects privacy by filtering messages locally, reducing data exposure risk.

Adaptability to Evolving Spam Techniques: The model adapts to evolving spam patterns, keeping security measures up to date.

Prevention of Unwanted Communication: The system blocks spam, preventing phishing and malware for a safer messaging experience.

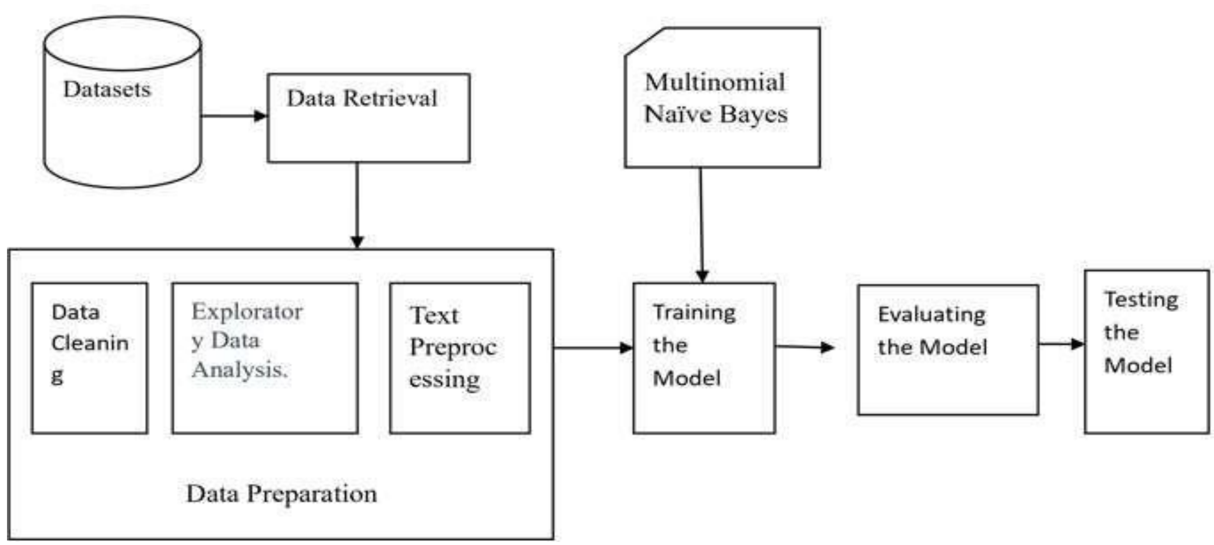
4. METHODOLOGY

4.1 Data Collection

The dataset from UCI includes labeled SMS messages, categorized as spam or non-spam. Data preprocessing involves cleaning and standardizing text data for efficient machine learning. Various statistical methods ensure comprehensive, high-quality input for accurate model training.

4.2 System Architecture

The architecture begins with data collection and cleaning, followed by exploratory data analysis (EDA) and preprocessing to enhance text quality. A Multinomial Naive Bayes classifier is trained on the processed dataset to detect spam. Finally, the model undergoes validation and testing, providing real-time spam classification on user messages.



5. RESULTS AND DISCUSSION

5.1 Performance

The model achieved an accuracy of 97% and a precision score of 1.0, showing strong predictive reliability. Evaluation metrics confirm robust classification of spam vs. non-spam messages. The system's lightweight design allows for efficient, real-time spam detection. Additionally, its accuracy minimizes false positives, enhancing user trust and satisfaction.

5.2 User Experience

The web interface allows users to easily check messages for spam, enhancing accessibility. Minimal processing time ensures a seamless, responsive user experience.

5.3 Security

The spam detection model improves SMS security by identifying and blocking potential threats. It minimizes exposure to phishing and malware, offering enhanced protection.

6. CONCLUSION

The Multinomial Naive Bayes algorithm proves effective in SMS spam detection, achieving high accuracy and precision. Its simplicity, combined with robust performance, makes it suitable for real-time applications. The model's adaptability to new spam patterns highlights its potential as a reliable spam filter. The project contributes to mobile communication security by providing users with a practical solution to filter unwanted messages. As SMS spam evolves, continuous model optimization will be crucial.

7. FUTURE SCOPE

Future developments for the SMS Spam Detection using Machine Learning include:

Incorporation of Ensemble Methods: Future work can use ensemble techniques to boost accuracy and robustness against spam.

Real-Time Adaptability: Real-time learning from new spam patterns can make the model more adaptive to evolving tactics.

User Feedback Integration: User feedback can refine the model, personalizing spam detection and improving precision.

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