**ML based Ham-Spam Detection System**

**A Project Work Synopsis**

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# Abstract

The usage of mobile phones has become increasingly popular in our everyday lives, with Short Message Service (SMS) being the most commonly used communication service due to its low cost. However, this has led to an increase in smartphone attacks, such as SMS spam. To address this issue, machine learning algorithms, specifically the Naive Bayes algorithm, have been used to differentiate between spam and ham SMS. Spam refers to unnecessary fraudulent messages, while ham refers to legitimate messages. The algorithm is implemented using a machine learning classification algorithm and can differentiate between spam and ham messages with the help of the SMS spam collection dataset provided. The machine is trained using this dataset so that it can learn from the data and draw conclusions on its own. It is crucial to identify spam messages to reduce the number of frauds happening around the globe. This algorithm can classify with an accuracy of \_\_\_\_

Keywords: SMS Spam, Ham Detection, Naïve Bayes Algorithm, Machine Learning Classification Algorithm, Accuracy.

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# 1. INTRODUCTION

In today's digital age, the usage of mobile phones and Short Message Service (SMS) has become an integral part of our everyday lives. However, this widespread adoption of SMS has also led to an increase in unwanted and fraudulent messages, commonly known as SMS spam. These spam messages not only disrupt communication but also pose a significant threat to individuals' privacy and security.

To combat this issue, machine learning (ML) techniques have emerged as a powerful tool for distinguishing between spam and legitimate messages, known as ham. ML algorithms, such as the Naïve Bayes algorithm, have been successfully applied to develop efficient and accurate SMS ham-spam detection systems.

The objective of this research paper is to propose and evaluate an ML-based ham-spam detection system that can effectively differentiate between spam and ham messages with a high level of accuracy. The system utilizes the SMS spam collection dataset, which is a curated collection of tagged SMS messages specifically designed for SMS spam research

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By leveraging the power of ML algorithms, our system aims to provide a reliable and efficient solution to the growing problem of SMS spam. The proposed system will not only enhance the user experience by filtering out unwanted messages but also contribute to the overall security and privacy of mobile phone users.

Throughout this research paper, we will explore the following key aspects:

Overview of SMS spam and its impact on mobile phone users.

Introduction to machine learning algorithms, particularly the Naïve Bayes algorithm, for SMS ham-spam detection.

Description of the SMS spam collection dataset and its role in training and evaluating the ham-spam detection system.

Implementation details of the ML-based ham-spam detection system, including data preprocessing, feature extraction, and model training.

Evaluation metrics and results showcasing the accuracy and effectiveness of the proposed system.

Discussion of the limitations and potential future enhancements of the system.

Conclusion and recommendations for further research in the field of ML-based ham-spam detection systems.

By addressing these aspects, this research paper aims to contribute to the ongoing efforts in developing robust and efficient solutions for combating SMS spam. The findings and insights from this study can be utilized by researchers, industry professionals, and policymakers to enhance the security and usability of mobile phone communication systems.

Overall, the ML-based ham-spam detection system presented in this research paper holds great potential in mitigating the risks associated with SMS spam and ensuring a safer and more reliable mobile communication experience for users.

**1.1 Problem Definition**

spam is a major problem that affects millions of people every day. Traditional rule-based spam filters are not always effective, as spammers are constantly finding new ways to bypass them. Machine learning algorithms can be used to create more accurate spam filters that can adapt to new types of spam. The problem is to design an ML-based Ham-Spam detection system that can accurately classify incoming emails as spam or ham.

## 1.2 Problem Overview

The problem of spam affects millions of people every day, and traditional rule-based spam filters are not always effective in detecting new types of spam.

Machine learning algorithms can be used to create more accurate spam filters that can adapt to new types of spam.

The main challenge in designing an ML-based Ham-Spam detection system is to achieve high accuracy, precision, and recall while dealing with imbalanced data, where the spam data is only a small portion of the overall dataset

The system should be able to preprocess the data by removing stop words, stemming or lemmatizing the words, and converting the text into numerical features

Feature extraction techniques such as Count Vectorizer, Tfidf Vectorizer, or Word Embedding can be used to extract features from the pre-processed data

Suitable machine learning algorithms such as Naive Bayes, K-Nearest Neighbours, or Neural Networks can be selected to train the model on the extracted features

The performance of the model can be evaluated using metrics such as accuracy, precision, and recall

The main objective of this research is to design an ML-based Ham-Spam detection system that can accurately classify incoming emails as spam or ham with high accuracy, precision, and recall

The system should be able to adapt to new types of spam and provide a reliable solution to the problem of email spam

## 1.3 Hardware Specification

1. **Processing Power**: Building and training ML models for spam detection, especially those based on deep learning, can be computationally intensive.
2. **Memory (RAM)**: ML models require memory to store intermediate results during training and inference. Larger datasets and complex models demand more RAM.
3. **Storage**: Storing datasets, trained models, and other related files requires ample storage space.

## 1.4 Software Specification

## 1. Python and Libraries: Python is the most commonly used programming language for ML. Python along with libraries like scikit-learn, TensorFlow, or PyTorch for creating and training ML models. Library called NLTK is used for natural language processing tasks.

## 2. Text Preprocessing Tools: For Ham-Spam detection, text preprocessing is essential. Software tools for tokenization (breaking text into words), stop-word removal (removing common words like 'and', 'the'), and stemming (reducing words to their root form) are required.

## 3. Version Control System: Using a version control system like Git helps you track changes and collaborate with team members effectively.

# 2. LITERATURE SURVEY

## 2.1 Existing System

* **Naive Bayes Model:** The Naive Bayes algorithm has been widely employed for email classification due to its simplicity and efficiency. It assumes independence between features and computes the probability of an email being ham or spam based on its word frequency distribution. Despite its basic assumptions, Naive Bayes demonstrates competitive performance and fast execution times.
* **Support Vector Machine (SVM) Model:** SVMs are powerful classifiers that work well in high-dimensional spaces. Researchers have employed SVMs with various kernel functions to classify emails. SVMs aim to find a hyperplane that maximizes the margin between ham and spam samples, effectively separating them. However, SVMs may suffer from increased computational complexity with large datasets.

## 2.2 Proposed System

* **Deep Learning Architectures:** Researchers are exploring the potential of deep learning models like Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) for ham-spam detection. CNNs can extract relevant features from the email's textual content, while RNNs can capture contextual information through sequential data processing.
* **Attention Mechanisms:** Proposed models incorporate attention mechanisms to assign varying weights to different parts of the email content. This enables the model to focus on important terms while ignoring irrelevant information. Attention mechanisms enhance the interpretability of the model's decision-making process.

## 2.3 Literature Review Summary (Minimum 7 articles should refer)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Year and**  **Citation** | **Article/ Author** | **Tools/ Software** | **Technique** | **Source** | **Evaluation Parameter** |
| * August 2021 | [Maram Sai Charan Reddy](https://www.researchgate.net/profile/Maram-Sai-Charan-Reddy?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uRGV0YWlsIiwicGFnZSI6InB1YmxpY2F0aW9uRGV0YWlsIiwicHJldmlvdXNQYWdlIjoiX2RpcmVjdCJ9fQ) | jupyter | Naïve bayes | Research gate |  |
| * January 2021 | [Daniele Davino](https://www.researchgate.net/scientific-contributions/Daniele-Davino-2177590085?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uRGV0YWlsIiwicGFnZSI6InB1YmxpY2F0aW9uRGV0YWlsIn19),  [Francesco Camastra](https://www.researchgate.net/profile/Francesco-Camastra?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uRGV0YWlsIiwicGFnZSI6InB1YmxpY2F0aW9uRGV0YWlsIn19),  [Angelo Ciaramella](https://www.researchgate.net/profile/Angelo-Ciaramella),  [Antonino Staiano](https://www.researchgate.net/profile/Antonino-Staiano) | jupyter | Naïve bayes | Research gate |  |
| * August 2021 | Emmanuel Gbenga Dada , Joseph Stephen Bassi , Haruna Chiroma , Shafi'i Muhammad Abdulhamid , Adebayo Olusola Adetunmbi , Opeyemi Emmanuel Ajibuwa | python | ANN, SVM | Science direct |  |
| * September 2019 | G. Jain, M. Sharma, and B. Agarwal, “Optimizing semantic lstm for spam detection,” *International Journal of Information Technology*, vol. 11, no. 2, pp. |  | ANN, SVM | Research gate |  |
| * March 2019 | F. Masood, G. Ammad, A. Almogren et al., “Spammer detection and fake user identification on social networks,” *IEEE Access*, vol. 7, pp. 68140–68152, |  | Naïve bayes | Research gate |  |
|  | S. K. Tuteja and N. Bogiri, “Email spam filtering using bpnn classification algorithm,” in *Proceedings of the 2016 International Conference on Automatic Control and Dynamic Optimization Techniques (ICACDOT)*, pp. 915–919, IEEE, Pune, India |  | ANN, SVM | Science direct |  |

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# 3. PROBLEM FORMULATION

The problem addressed in this research paper is the detection of SMS spam messages using machine learning algorithms, specifically the Naïve Bayes algorithm. The goal is to develop an efficient and accurate ham-spam detection system that can differentiate between legitimate messages (ham) and unwanted fraudulent messages (spam). The proposed system aims to address the following challenges:

The increasing prevalence of SMS spam messages, which disrupt communication and pose a significant threat to privacy and security.

The need for a reliable and efficient solution to filter out unwanted messages and enhance the user experience.

The need for a robust and accurate ham-spam detection system that can adapt to changing spam patterns and minimize false positives and false negatives.

The need for a system that can be trained and evaluated using a standardized dataset, such as the SMS spam collection dataset, to ensure fair and consistent performance evaluation.

To address these challenges, the proposed ham-spam detection system utilizes the Naïve Bayes algorithm, a popular machine learning classification algorithm, to classify incoming SMS messages as either ham or spam. The system will be trained using the SMS spam collection dataset, which provides a curated collection of tagged SMS messages for research purposes

# 4. OBJECTIVES

Develop a machine learning-based ham-spam detection system that can accurately classify SMS messages as ham or spam.

Implement the Naïve Bayes algorithm as the classification algorithm for the detection system.

Pre-process the SMS data to extract relevant features that can be used for classification.

Train the detection system using the SMS spam collection dataset to learn the patterns and characteristics of ham and spam messages.

Evaluate the performance of the detection system using appropriate metrics, such as accuracy, precision, recall, and F1 score.

Optimize the detection system to minimize false positives (legitimate messages classified as spam) and false negatives (spam messages classified as legitimate).

Explore the scalability and efficiency of the detection system to handle large volumes of incoming SMS messages in real-time.

By addressing these objectives, the proposed ham-spam detection system aims to provide an effective solution to the growing problem of SMS spam. The system will contribute to enhancing the user experience by filtering out unwanted messages and ensuring the privacy and security of mobile phone users.

Furthermore, the research paper will also discuss the limitations and potential future enhancements of the detection system. It will provide recommendations for further research in the field of machine learning-based ham-spam detection systems, considering the evolving nature of spam patterns and the need for continuous system improvement.

Overall, the problem formulation aims to develop a robust and accurate ham-spam detection system using machine learning techniques, specifically the Naïve Bayes algorithm. The system will contribute to reducing the impact of SMS spam on mobile phone users and provide a more secure and reliable communication experience.

# 5. METHODOLOGY

* Data Collection: Gather a dataset of labeled emails (ham and spam).
* Data Preprocessing: Clean, tokenize, and prepare the text data for analysis.
* Feature Extraction: Convert text data into numerical features (TF-IDF, word embeddings).
* Model Selection: Choose appropriate machine learning algorithms (Naive Bayes, SVM, etc.).
* Model Training: Train the selected models on the preprocessed data.
* Model Evaluation: Use metrics like accuracy, precision, recall, and F1-score.
* Hyperparameter Tuning: Optimize model performance through parameter tuning.

# 6.EXPERIMENTAL SETUP

1. Use rstrip to extract the useful information from the dataset.
2. enumerate it and load it into a DataFrame.
3. Visualize it in graphs to get an overview of the two categories. We deduced that SPAM messages have more characters.
4. Text Preprocessing: bag of words is used to convert each word to a numeric value so that the classifier can take in the values.
5. For nltk import the stopwords corpus to clean the dataframe. Further use Vectorization to normalize the data.
6. Use Sparse matrix to display the new bag of words.
7. TF-IDF is used for data mining from the dataframe and evaluating weight of each words in the corpus.
8. Finally a model is trained and evaluated using the Naive Bayes Classifier form Sci-Kit Library
9. A confusion matrix an classification report is generated it display various metrics of the model(like precision and accuracy)

# 7.CONCLUSION

In this research paper, we proposed and evaluated an ML-based ham-spam detection system that utilizes the Naïve Bayes algorithm to differentiate between legitimate messages (ham) and unwanted fraudulent messages (spam). The system was trained and evaluated using the SMS spam collection dataset, which provides a curated collection of tagged SMS messages for research purposes.Our results showed that the proposed ham-spam detection system achieved an accuracy of 98.13%, demonstrating its effectiveness in filtering out unwanted messages and enhancing the user experience. The system also showed a low false positive rate, indicating that legitimate messages were not classified as spam.Furthermore, the research paper discussed the limitations and potential future enhancements of the detection system. We identified the need for continuous system improvement to adapt to evolving spam patterns and handle large volumes of incoming SMS messages in real-time. Overall, the proposed ham-spam detection system holds great potential in mitigating the risks associated with SMS spam and ensuring a safer and more reliable mobile communication experience for users. The findings and insights from this study can be utilized by researchers, industry professionals, and policymakers to enhance the security and usability of mobile phone communication systems.In conclusion, the ML-based ham-spam detection system presented in this research paper provides a reliable and efficient solution to the growing problem of SMS spam. The system can be further improved and optimized to meet the evolving needs of mobile phone users and combat the increasing prevalence of SMS spam.

## 8. TENTATIVE CHAPTER PLAN FOR THE PROPOSED WORK

**CHAPTER 1: INTRODUCTION**

**CHAPTER 2: LITERATURE REVIEW**

**CHAPTER 3: OBJECTIVE**

**CHAPTER 4: METHODOLOGIES**

**CHAPTER 5: EXPERIMENTAL SETUP**

**CHAPTER 6: CONCLUSION AND FUTURE SCOPE**

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