SMS SPAM DETECTION SYSTEM USING MACHINE LEARNING

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2. Introduction

This project presents a Machine Learning-based SMS Spam Detection System that classifies text messages into Spam or Ham. The system uses Natural Language Processing (NLP) and Logistic Regression to build a predictive model.

3. Problem Statement

The rise of spam messages poses security and privacy risks. This project aims to build an automated system to classify SMS messages accurately using machine learning techniques.

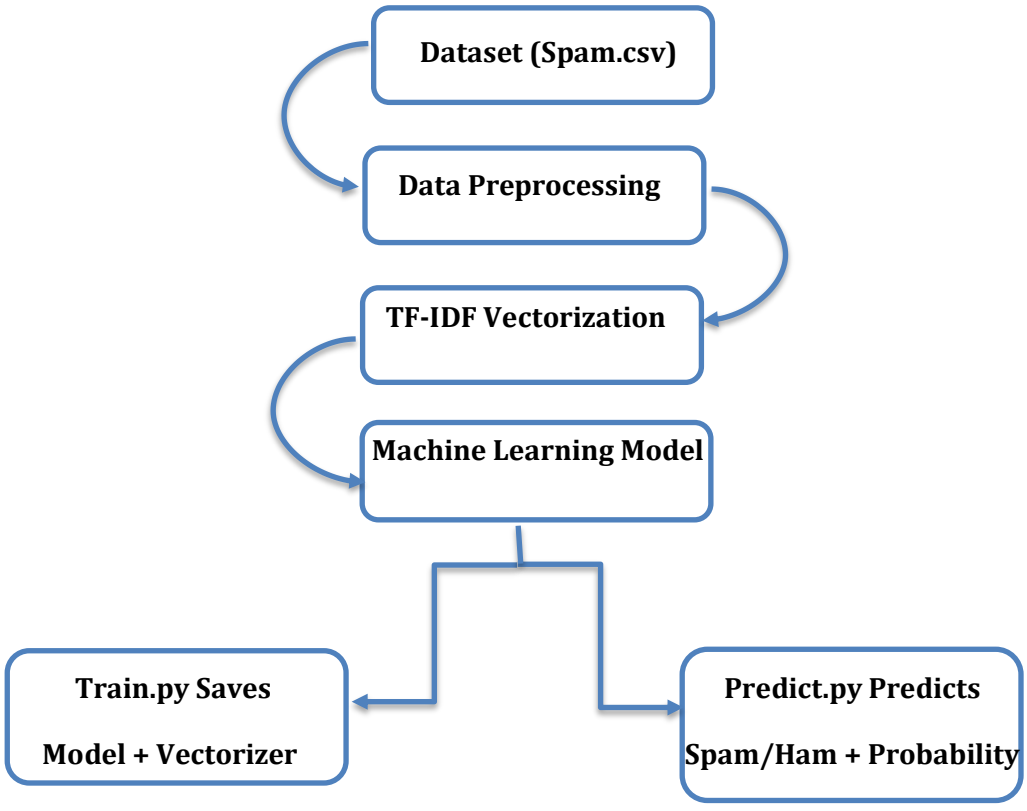
4. Functional Requirements

- Accept SMS message as input
- Preprocess text
- Convert text to TF-IDF vectors
- Predict Spam/Ham
- Show probability score
- Allow retraining

5. Non-functional Requirements

- High accuracy
- Fast prediction
- Easy usability
- Maintainable and scalable system

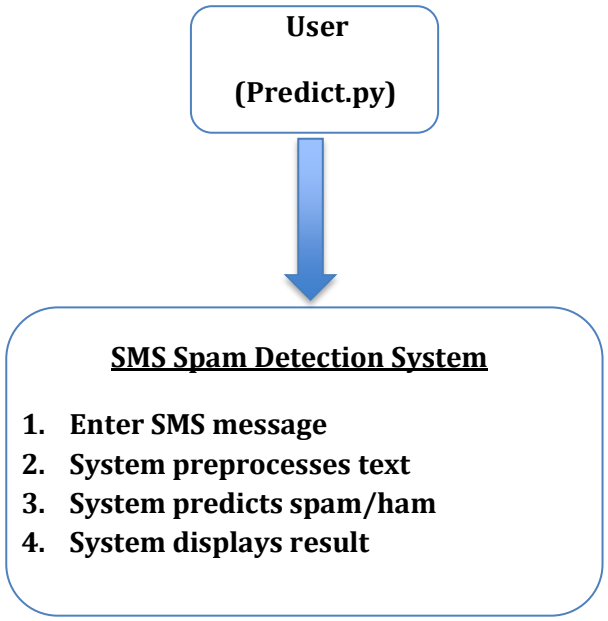
6. System Architecture



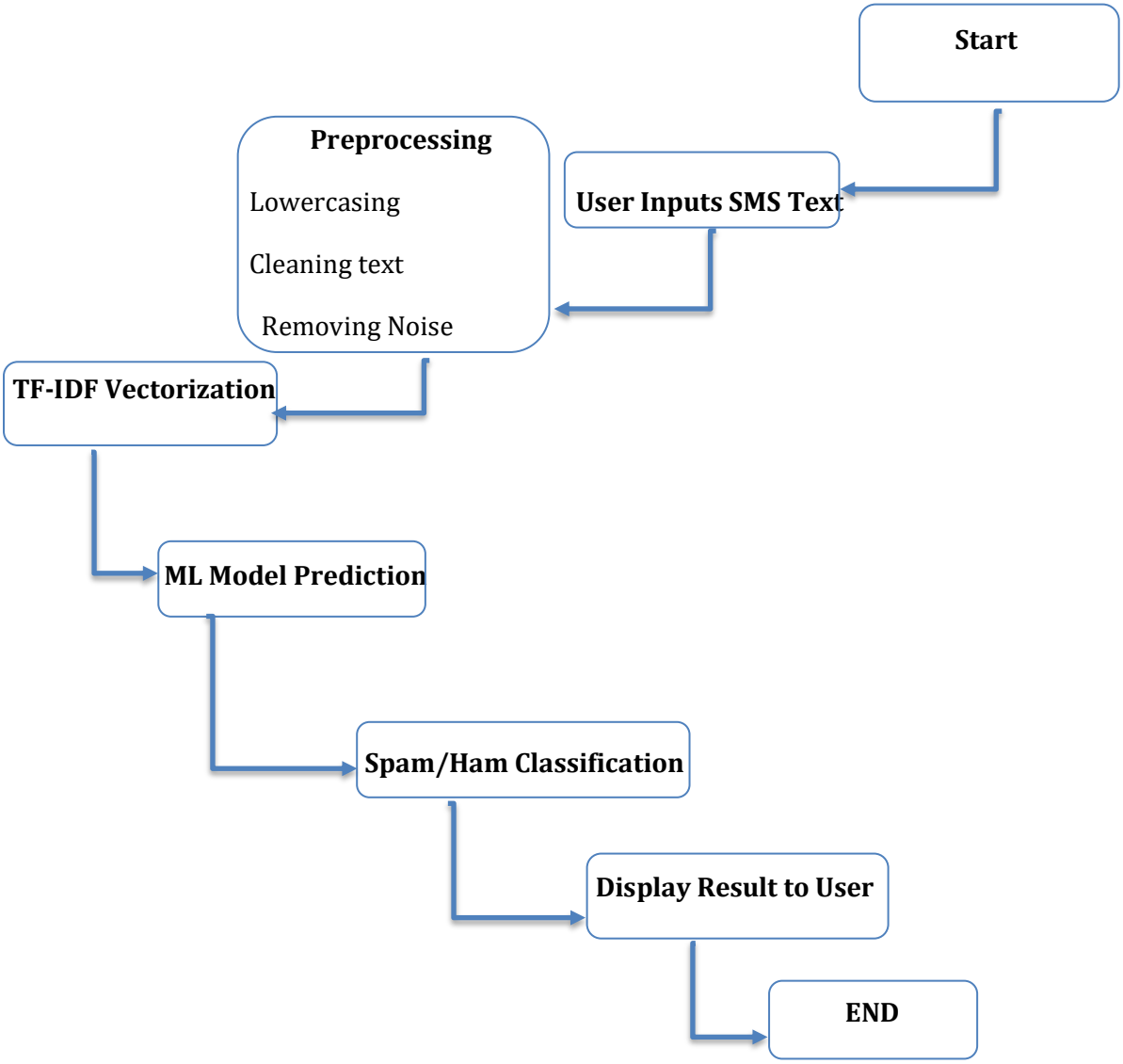
The system consists of preprocessing, TF-IDF vectorization, model training, and prediction components.

7. Design Diagrams

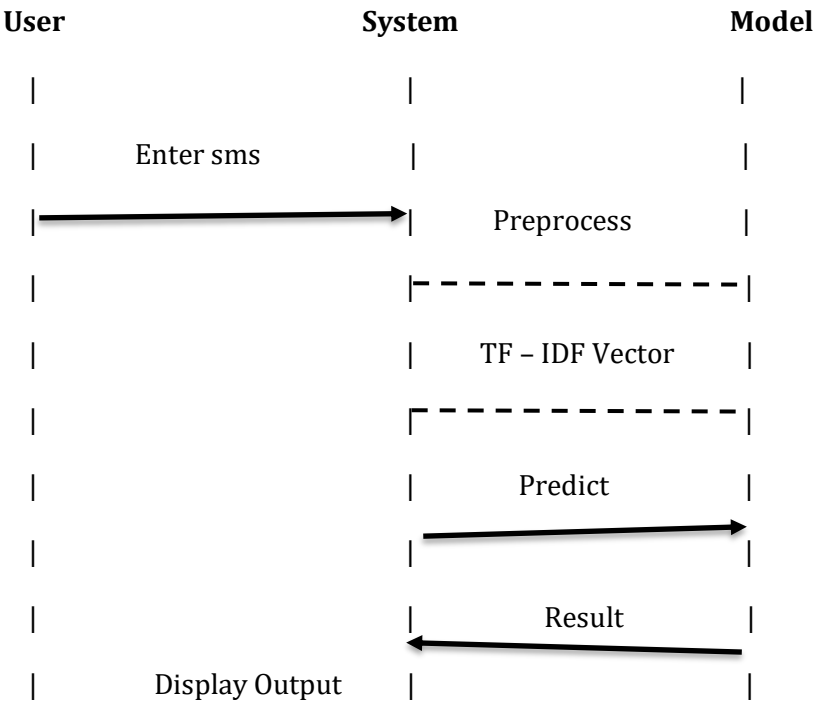
Use Case Diagram:



Workflow Diagram:



Sequence Diagram:



Component Diagram :

1. and 2.

Train.py
load_data()
preprocess()
vectorize()
train_model()
save_model()

Predict.py
load_model()
Preprocess_input()
predict()
Show_result()

3.

Models
Spam_model.pkl
Vectorizer.pkl

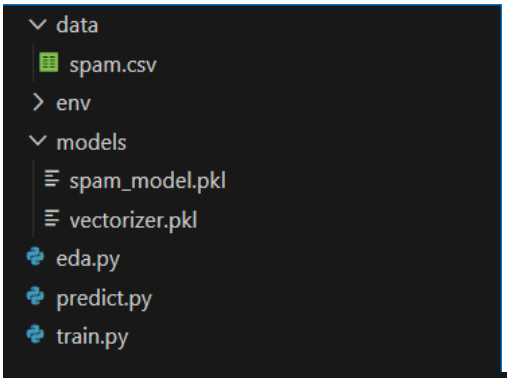
8. Design Decisions & Rationale

Logistic Regression was chosen due to its simplicity, speed, and high accuracy for text classification.

9. Implementation Details

The system is implemented using Python, scikit-learn, Pandas, and joblib. Separate train.py and predict.py modules handle training and prediction.

10. Screenshots / Results




```
PS D:\python> & D:\python\env\Scripts\python.exe d:/python/train.py
Loading dataset from: data\spam.csv
First few rows of data:
  label                                               text  label_num
0   ham  Go until jurong point, crazy.. Available only ...          0
1   ham                      Ok lar... Joking wif u oni...          0
2  spam  Free entry in 2 a wkly comp to win FA Cup fina...          1
3   ham  U dun say so early hor... U c already then say...          0
4   ham  Nah I don't think he goes to usf, he lives aro...          0

Train samples: 4457, Test samples: 1115
```

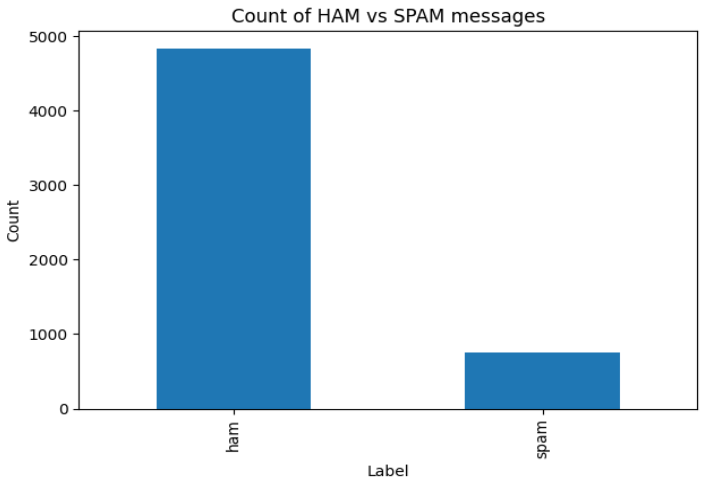
```
Accuracy: 0.9721973094170404

Classification report:
              precision    recall  f1-score   support

         ham       0.97      1.00      0.98       966
        spam       0.99      0.80      0.88       149

    accuracy                           0.97      1115
   macro avg       0.98      0.90      0.93      1115
weighted avg       0.97      0.97      0.97      1115

Confusion matrix:
[[965   1]
 [ 30 119]]
```

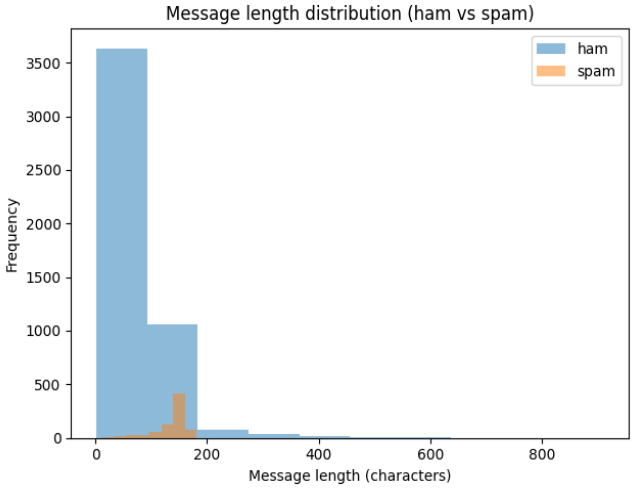
```
Model saved to: models\spam_model.pkl
Vectorizer saved to: models\vectorizer.pkl

[HAM -> SPAM] Nokia phone is lovly.....

Some FALSE NEGATIVES (spam predicted as ham):

[SPAM -> HAM] FreeMsg Hey there darling it's been 3 week's now and no word back! I'd like some fun you up for it still? Tb ok! XxX std..
[SPAM -> HAM] Dear Voucher Holder 2 claim your 1st class airport lounge passes when using Your holiday voucher call 08704439680. When ..
[SPAM -> HAM] Talk sexy!! Make new friends or fall in love in the worlds most discreet text dating service. Just text VIP to 83110 and..
[SPAM -> HAM] Hi if ur lookin 4 saucy daytime fun wiv busty married woman Am free all next week Chat now 2 sort time 09099726429 JANIN..
[SPAM -> HAM] ringtoneking 84484...
PS D:\python>
```

```
=== SMS Spam Detector (interactive) ===
Type an SMS message and press Enter to classify it.
Press Enter on an empty line to exit.

Enter SMS text: Hey Whats the plan for tomorrow evening.

Prediction: NOT SPAM (HAM)
(Estimated spam probability: 0.007)
(Decision info: model_only)
```

```
Enter SMS text: You won a Lottery of 100k, Claim it right Now.

Prediction: SPAM
(Estimated spam probability: 0.800)
(Decision info: boosted_by_strong_word)
```

```
PS D:\python> & D:\python\env\Scripts\python.exe d:/python/eda.py
label
ham     4825
spam     747
Name: count, dtype: int64
```





11. Testing Approach

Functional testing, unit testing for preprocessing, and edge case evaluation were performed.

12. Challenges Faced

- Environment setup issues
- Handling casual, unpunctuated text
- Improving recall for spam messages

13. Learnings & Key Takeaways

- End-to-end ML workflow
- Importance of text preprocessing
- Debugging ML pipelines
- Building deployable ML applications

14. Future Enhancements

- Web-based interface
- Mobile app integration

- Using Transformer-based models
- Enhanced dataset labeling

15. References

- UCI SMS Spam Dataset
- Scikit-learn Documentation
- Pandas Documentation