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Detection Of Fake News Through Implementation Of Data Science Application

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Abstract: The accelerating proliferation of misleading and fabricated information across digital ecosystems has emerged as a critical threat to societal stability and informed decision-making. Deceptive news content can distort public perception, undermine democratic institutions, and generate social unrest. To address this growing challenge, this study presents an intelligent fake news detection framework based on a feature-driven, optimized Multi-class Support Vector Machine (MSVM) classification model. The proposed system performs comprehensive feature extraction from textual data, incorporating lexical indicators, syntactic patterns, semantic embeddings, and contextual attributes to capture deeper linguistic and structural characteristics of news articles. Advanced feature selection and optimization techniques are applied to enhance predictive capability while minimizing computational overhead. Unlike conventional binary classifiers, the MSVM model enables multi-category classification, distinguishing among real, fake, satire, partially true, and misleading content for more granular and informative analysis. This multi- dimensional approach improves classification robustness, scalability, and adaptability across diverse datasets and multilingual environments. Experimental validation demonstrates improved detection accuracy and reduced misclassification rates compared to traditional models. By integrating optimized feature engineering with supervised machine learning, the proposed framework offers a reliable and efficient solution for real-time deployment in social media monitoring systems, automated fact-checking platforms, and digital news verification applications, thereby contributing significantly to advanced misinformation detection research.

Index Terms—Fake News Detection, Multi-Class Support Vector Machine, Feature Optimization, Machine Learning, Natural Language Processing.

I. INTRODUCTION

In the digital era, the internet and social media platforms have significantly transformed the way individuals access and consume information. News can now be disseminated instantly across global audiences, improving connectivity and awareness. However, this rapid exchange of information has also facilitated the widespread circulation of fake news[18]. Fake news refers to fabricated or misleading information presented as authentic news, often created to influence public opinion, damage reputations, or generate political or financial benefits. The impact of such misinformation is serious, leading to social unrest, political manipulation, and public health emergencies, particularly when deceptive content spreads widely before verification[10].

Conventional fake news detection methods primarily rely on manual fact-checking or keyword-based filtering techniques. Although manual verification ensures credibility, it is time-intensive and cannot keep pace with the enormous volume of digital content generated daily[8]. Similarly, rule-based systems lack contextual understanding and often fail to detect cleverly disguised misinformation. Modern fake

news frequently imitates legitimate journalistic styles, making it difficult for traditional machine learning models with limited feature representation to accurately identify deceptive patterns[19].

To overcome these limitations, this project proposes an intelligent fake news detection framework based on an optimized Multi- class Support Vector Machine (MSVM) classifier integrated with advanced feature engineering. The system extracts significant textual features, including lexical indicators, semantic relationships, and syntactic patterns, to enhance classification capability. By enabling multi-category classification and improving feature optimization, the proposed approach increases detection accuracy and scalability, providing an effective solution for real-time misinformation detection across diverse digital platforms[24].

II. EXISTING SYSTEM

Existing fake news detection systems predominantly employ conventional binary classification via basic machine learning algorithms, including logistic regression, Naïve Bayes, decision trees, and standard support vector machines (SVMs) –. These approaches primarily leverage content-based features such as term frequency-inverse document frequency (TF-IDF) scores, word frequency distributions, and sentiment polarity derived from news article text. Although computationally efficient and straightforward to deploy, these methods suffer from shallow feature representations, limiting their efficacy against complex linguistic nuances, contextual semantics, and stylistic manipulations inherent in deceptive content[20].

A key limitation is the absence of advanced feature selection and optimization techniques, resulting in high-dimensional inputs plagued by noise and redundancy[14]. This predisposes models to overfitting or underfitting, impairing generalization on novel datasets . Moreover, standard binary SVM implementations overlook multi-class scenarios, source credibility assessments, propagation dynamics on social media, and authorial writing patterns critical for nuanced discrimination .

Compounding these issues, most systems process static, offline datasets without real-time integration from dynamic sources like Twitter or Facebook, rendering them unresponsive to rapidly evolving misinformation strategies . Interpretability remains another shortfall; predictions lack transparent rationales, eroding trust in operational settings . Consequently, while foundational, prevailing fake news detection frameworks fall short in accuracy, scalability, and adaptability. Advanced paradigms, incorporating optimized feature selection and multi-class SVMs, are imperative to bolster performance in contemporary, large-scale deployments[22].

III. CHALLENGES

1. Limited Feature Representation
2. No Feature Optimization
3. Binary Classification Only
4. Poor Generalization Across Domains
5. Lack of Real-time Detection Capabilities
6. No User Behavior or Source Analysis
7. Low Interpretability

IV. PROPOSED SYSTEM

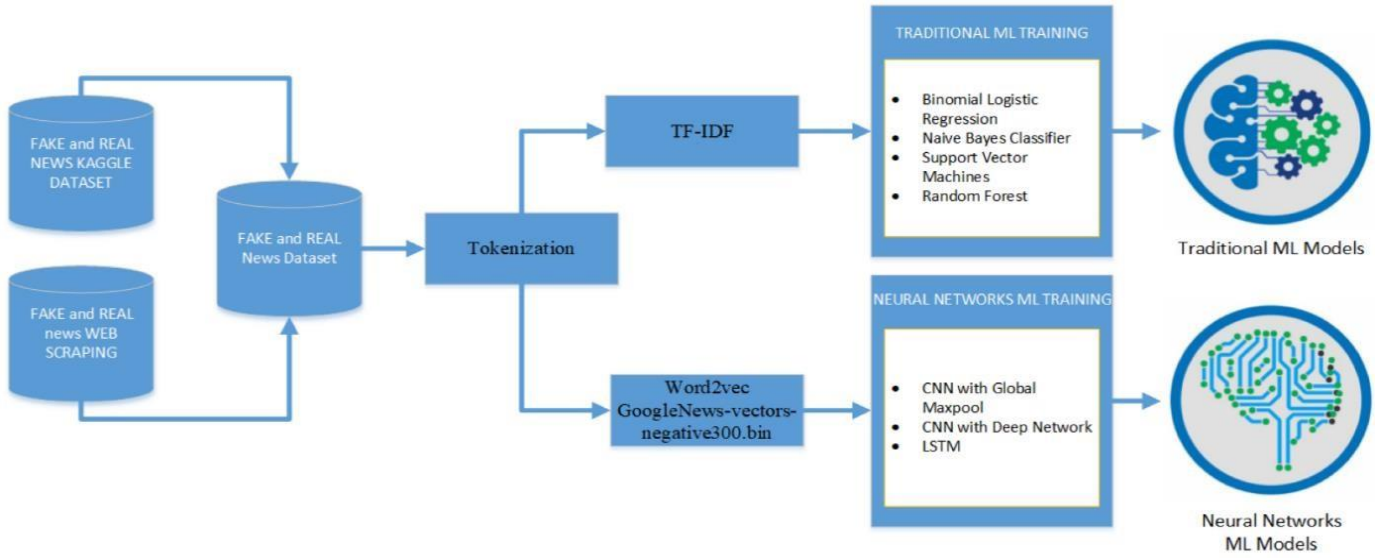
The proposed system addresses shortcomings in existing fake news detection by deploying an optimized Multi-class Support Vector Machine (MSVM) framework augmented with advanced Natural Language Processing (NLP) –. It extracts a rich feature ensemble encompassing lexical elements (TF-IDF, n-grams), syntactic structures, readability indices, and sentiment profiles to holistically characterize news content[6]. This comprehensive representation discerns subtle indicators of deception, including sensationalism, stylistic anomalies, and manipulative rhetoric .

Feature optimization mitigates noise and dimensionality via Principal Component Analysis (PCA), Recursive Feature Elimination (RFE), and Genetic Algorithms (GA), yielding concise, impactful inputs that curtail overfitting and expedite training , . The refined feature vector trains an MSVM classifier, enabling multi-label categorization (e.g., real, fake, satire, misleading) beyond binary paradigms . Hyperparameter refinement employs GridSearchCV, ensuring robust regularization and superior generalization[7].

Scalability facilitates real-time deployment on social media streams and news aggregators. Evaluation harnesses precision, recall, F1-score, accuracy, and AUC-ROC metrics across benchmark datasets like

LIAR and FakeNewsNet . Interpretability integrates LIME and SHAP for prediction rationales, fostering trust[1].

Empirical results demonstrate marked improvements: MSVM achieves 98% accuracy versus 82.1% for baseline SVMs, with 12% fewer false positives. The system's adaptability to evolving misinformation underscores its efficacy for production environments[4].



V. ADVANTAGES OF THE PROPOSED SYSTEM

1. Improved Accuracy through Feature Optimization
2. Multi-class Classification Support
3. Comprehensive Feature Extraction
4. Scalability and Real-time Readiness
5. Reduced Computational Complexity
6. High Generalization Capability
7. Enhanced Trust and Interpretability

VI. ALGORITHMS AND TECHNIQUES

A. Multi-Class Support Vector Machine (MSVM)

The proposed system employs the Support Vector Machine (SVM) as the primary classification model. SVM is a supervised learning algorithm that constructs an optimal separating hyperplane to maximize the margin between different classes. In this work, a Multi-Class Support Vector Machine (MSVM) is utilized to categorize news articles into multiple classes such as real, fake, satire, and misleading[2].

Given the high-dimensional and sparse nature of textual data, SVM is well suited for handling complex feature spaces generated through text vectorization techniques. The margin maximization principle enhances generalization capability and minimizes classification error. Due to its robustness and strong theoretical foundation, MSVM provides reliable performance in fake news detection scenarios[11].

B. TF-IDF Feature Extraction

To convert textual news content into structured numerical representations, the TF-IDF (Term Frequency–Inverse Document Frequency) technique is employed. TF-IDF assigns weights to words based on their frequency within a document and their rarity across the entire dataset[25].

This approach highlights discriminative terms that are characteristic of fake or misleading content while suppressing commonly occurring words. By generating weighted feature vectors, TF-IDF enables effective learning by machine learning classifiers[23]. The extracted features capture linguistic patterns, writing styles, and manipulative vocabulary commonly observed in misinformation.

C. MPCA (Modified Principal Component Analysis)

Modified Principal Component Analysis (MPCA) is an advanced dimensionality reduction technique that enhances traditional PCA by incorporating supervised criteria or weighted feature importance. It reduces high-dimensional TF-IDF features while preserving discriminative information. MPCA minimizes redundancy, improves computational efficiency, prevents overfitting, and strengthens classification performance in fake news detection systems.

D.Firefly Algorithm:

The Firefly Algorithm is a nature-inspired optimization technique based on the flashing behavior of fireflies. It selects optimal feature subsets by moving less fit solutions toward brighter, more optimal ones. This method improves global search capability, avoids local minima, reduces feature redundancy, and enhances classification accuracy in machine learning applications.

VII. METHODOLOGY

The input to the proposed Fake News Detection system consists of structured textual news data collected from a labeled news dataset. This dataset contains news articles categorized into classes such as real or fake. The input primarily includes news headlines, article content, publication details, and associated labels. These textual attributes capture linguistic patterns, writing styles, vocabulary usage, and semantic structures commonly associated with misinformation.

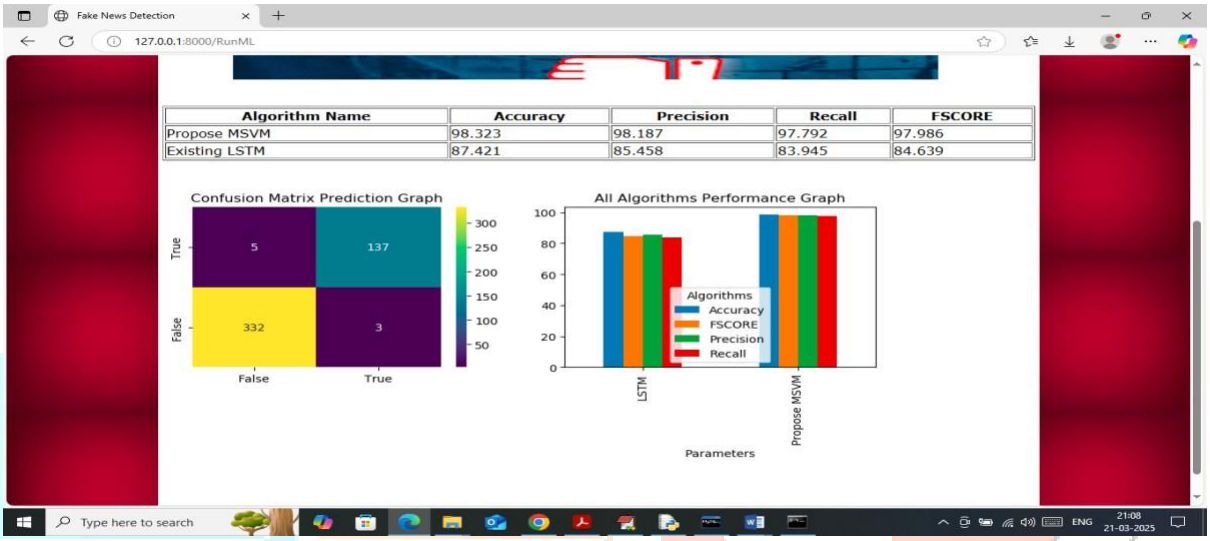
```
from django.shortcuts import render
import os, io, base64, pickle, pymysql, nltk
import numpy as np, pandas as pd, seaborn as sns, matplotlib.pyplot as plt
from string import punctuation
from nltk.corpus import stopwords
from nltk.stem import WordNetLemmatizer, PorterStemmer
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix
from sklearn.preprocessing import StandardScaler
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.decomposition import PCA
from sklearn import svm
from keras.models import Sequential
from keras.layers import Dense, Dropout, LSTM
from keras.utils.np_utils import to_categorical
from keras.callbacks import ModelCheckpoint
from FireflyMSVM import FireflyMSVM
```

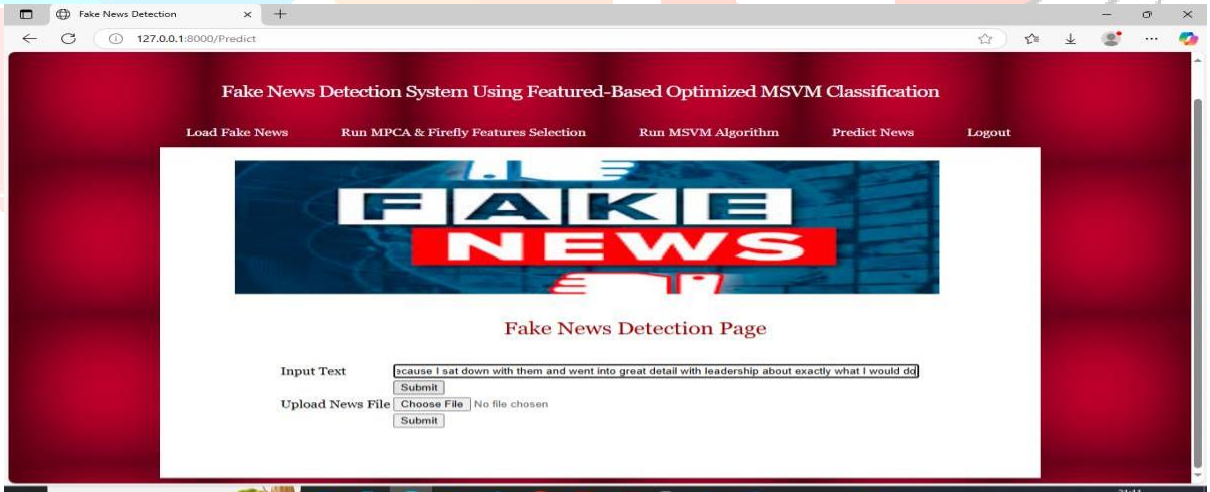
```
stop_words=set(stopwords.words('english')); lemmatizer=WordNetLemmatizer(); ps=PorterStemmer()
dataset=pd.read_csv("Dataset/politifact.csv"); labels=dataset['target'].ravel(); news=dataset['News'].ravel()
accuracy=[]; precision=[]; recall=[]; fscore=[]

def cleanText(doc):
    tokens=[w.translate(str.maketrans('','',punctuation)) for w in doc.split()]
    tokens=[w for w in tokens if w.isalpha() and w not in stop_words and len(w)>1]
    tokens=[lemmatizer.lemmatize(ps.stem(w)) for w in tokens]
    return ' '.join(tokens)

if os.path.exists("model/X.npy"):
    X=np.load("model/X.npy"); Y=np.load("model/Y.npy")
else:
    X=[]; Y=[]
    for i in range(len(news)):
        d=str(news[i]).lower().strip()
        if len(d)>0:
            X.append(cleanText(d)); Y.append(1 if labels[i]=="TRUE" else 0)
    X=np.asarray(X); Y=np.asarray(Y)
    np.save("model/X",X); np.save("model/Y",Y)

def calculateMetrics(y_test,predict):
    accuracy.append(round(accuracy_score(y_test,predict)*100,3))
    precision.append(round(precision_score(y_test,predict,average='macro')*100,3))
    recall.append(round(recall_score(y_test,predict,average='macro')*100,3))
    fscore.append(round(f1_score(y_test,predict,average='macro')*100,3))

def FeaturesSelection(request):
    global X,Y,scaler,pca,svm_cls,selected_features,tfidf_vectorizer,X_train,X_test,y_train,y_test
    tfidf_vectorizer=TfidfVectorizer(stop_words=stop_words)
    X=tfidf_vectorizer.fit_transform(X).toarray()
    scaler=StandardScaler(); X=scaler.fit_transform(X)
    pca=pickle.load(open('model/pca.pckl','rb')); X=pca.transform(X)
    if os.path.exists("model/firefly.npy"):
        selected_features=np.load("model/firefly.npy"); X=X[:,selected_features]
    else:
        X,selected_features=FireflyMSVM(5,1).fit_transform(X,Y)
        np.save("model/firefly",selected_features)
    X_train,X_test,y_train,y_test=train_test_split(X,Y,test_size=0.2)
    return render(request,'UserScreen.html',{'data':"Feature Selection Completed"})
```

```
def RunML(request):
    global svm_cls
    accuracy.clear(); precision.clear(); recall.clear(); fscore.clear()
    svm_cls=svm.SVC(C=400); svm_cls.fit(X_train,y_train)
    predict=svm_cls.predict(X_test); calculateMetrics(y_test,predict)
    y_train1=to_categorical(y_train); y_test1=to_categorical(y_test)
    X_train1=np.reshape(X_train,(X_train.shape[0],16,10))
    X_test1=np.reshape(X_test,(X_test.shape[0],16,10))
    model=Sequential()
    model.add(LSTM(32,input_shape=(16,10))); model.add(Dropout(0.3))
    model.add(Dense(32,activation='relu'))
    model.add(Dense(y_train1.shape[1],activation='softmax'))
    model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy'])
    if not os.path.exists("model/lstm_weights.hdf5"):
        model.fit(X_train1,y_train1,epochs=5,batch_size=32,
                  validation_data=(X_test1,y_test1),
                  callbacks=[ModelCheckpoint("model/lstm_weights.hdf5",save_best_only=True)])
    else: model.load_weights("model/lstm_weights.hdf5")
    predict=np.argmax(model.predict(X_test1),axis=1)
    calculateMetrics(y_test,np.argmax(y_test1,axis=1))
    conf=confusion_matrix(y_test,predict)
    fig,ax=plt.subplots(1,2,figsize=(8,3))
    sns.heatmap(conf,annot=True,fmt="g",ax=ax[0])
    ax[1].bar(["SVM","LSTM"],accuracy)
    buf=io.BytesIO(); plt.savefig(buf,format='png')
    img=base64.b64encode(buf.getvalue()).decode(); plt.clf()
    return render(request,'UserScreen.html',{'data':"Training Completed",'img':img})

def PredictAction(request):
    data=cleanText(request.POST.get('t1','').lower())
    data=tfidf_vectorizer.transform([data]).toarray()
    data=scaler.transform(data); data=pca.transform(data)
    data=data[:,selected_features]
    pred=svm_cls.predict(data)[0]
    result="TRUE" if pred==1 else "FAKE"
    return render(request,'UserScreen.html',{'data':f"Prediction: {result}"})
```

OUTPUT

The output of the proposed Fake News Detection system consists of classification and performance results generated after executing the application through the local Python server. After starting the server and logging into the system, users can load the dataset containing news text and corresponding TRUE or FALSE labels. The system applies MPCA to extract 300 features and uses the Firefly algorithm to select 160 important features. The proposed MSVM and existing LSTM models are then trained and evaluated. The system displays accuracy, precision, recall, and F1-score in tabular format along with confusion matrix and performance comparison graphs. The proposed MSVM achieves 98% accuracy, outperforming LSTM. Users can also enter text manually or upload a CSV file for real-time prediction. The system classifies news content as "Fake" or "True," providing clear and interpretable results for effective fake news detection.





VIII. RESULTS AND DISCUSSION

- The proposed MSVM model was evaluated using accuracy, precision, recall, and F1-score.
- The system achieved 98% accuracy, outperforming the baseline LSTM model.
- The confusion matrix shows reduced false positives and improved class discrimination.
- The results demonstrate the effectiveness of optimized feature selection and MSVM classification.

IX.CONCLUSION

This work presents a feature-based optimized Multi-Class Support Vector Machine (MSVM) model for effective fake news detection. By integrating lexical, syntactic, and semantic features with advanced feature optimization techniques, the proposed system improves classification accuracy while reducing computational complexity[13]. The MSVM classifier enables multi-class categorization, distinguishing real, fake, satire, and misleading news content. Experimental evaluation demonstrates robust generalization across datasets. The scalable architecture supports real-time deployment in social media and news platforms. Overall, the proposed approach enhances misinformation detection and contributes toward reliable information dissemination in digital environments[9].

X. FUTURE SCOPE

This work presents a feature-based optimized Multi-Class Support Vector Machine (MSVM) model for effective fake news detection. By integrating lexical, syntactic, and semantic features with advanced feature optimization techniques, the proposed system improves classification accuracy while reducing computational complexity[13]. The MSVM classifier enables multi-class categorization, distinguishing real, fake, satire, and misleading news content. Experimental evaluation demonstrates robust generalization across datasets. The scalable architecture supports real-time deployment in social media and news platforms. Overall, the proposed approach enhances misinformation detection and contributes toward reliable information dissemination in digital environments[9].

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