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SentioNet: Real-Time Sentiment and Emotion Analysis Using Artificial Intelligence and Machine Learning

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Abstract - Understanding human sentiment and emotions is important for developing intelligent and interactive applications. This paper presents SentioNet, a web-based system that uses Artificial Intelligence (AI) and Machine Learning (ML) techniques to analyse sentiment from text and emotions from voice input. The proposed system provides three major modes of analysis: text sentiment analysis, audio file emotion analysis, and live microphone emotion analysis. For text input, natural language processing techniques are applied to classify the given text into positive, negative, or neutral sentiment categories. For voice input, acoustic characteristics are extracted using Mel-Frequency Cepstral Coefficients (MFCC) and processed using a machine learning model to recognize the emotion expressed in the speech. The live microphone module records short audio segments and makes near real-time predictions of emotions. The system displays the predicted sentiment or emotion with confidence and probability values, which help the users to easily understand the results. SentioNet, developed using Python, Flask, HTML, CSS and JavaScript, demonstrates the integration of AI, ML, text processing, and speech analysis in one interactive platform and can be useful in applications such as feedback analysis, customer interaction, and human-computer interaction. It's a fun and interactive way to learn the meaning of words and the emotions expressed in voice. This work shows how AI and ML can be worked together to create a real-time sentiment and emotion analysis system that is efficient and useful.

Keywords: Artificial Intelligence, Emotion Recognition, Machine Learning, MFCC, Sentiment Analysis

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1. INTRODUCTION

In today's digital world, people express their opinions and feelings through text messages, social-media posts, and spoken words. Understanding these sentiments and emotions is useful for many applications, such as customer feedback systems, chatbots, mental health monitoring, and smart interactive tools.

Sentiment analysis examines written text and decides whether the feeling is positive, negative, or neutral. Emotional analysis from voice tries to detect the emotions, such as happy, sad, angry, or neutral, by the sound of the speech.

Traditional systems often work only with text or only voice. They also typically process data offline. Real-time systems that can handle both text and live voices are still limited.

This study introduces SentioNet, a simple web-based platform that solves this problem.

SentioNet offers three easy methods:

1. Text sentiment analysis

2. Emotion analysis from uploaded audio files

3. Real-time emotion detection from live microphone input

Key contributions of this study:

- A single interactive platform that supports both text and voice analysis
- Use of NLP for clean and accurate text sentiment classification
- Use of MFCC features with machine learning for emotional recognition from speech
- Real-time prediction from the live microphone input
- Simple and user-friendly display of results with confidence and probability values

2. Literature Review

2.1 Sentiment analysis from text

Many researchers have worked on text sentiment analysis [1]. Early methods used simple word lists (lexicons). Later, machine learning models, such as naïve Bayes and support vector machines, became popular. Deep learning models, such as CNN and LSTMs improved accuracy by better understanding context. Recent transformer models, such as BERT [6], provide very high accuracy but require more computing power.

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2.2 Emotion recognition from speech

Speech emotion recognition usually begins by extracting acoustic features. Mel-frequency cepstral coefficient (MFCC) is one of the most widely used features because they capture how the human ear hears sound [4]. After extracting MFCCs, researchers apply machine learning or deep learning models to classify emotions [3] Tiwari et al. [3] models, such as SVM, Random Forest, or neural networks, to classify emotions.

2.3 Real-time and Hybrid Systems

Some recent systems have attempted to combine text and speech analysis. Kupcova et al. [2]. Developed a web-based speech emotion recognition system that supports both audio file upload and live microphone input. Siva at al [5] However, many of them are complex, require heavy hardware, or do not support live microphone input easily. There is still a need for a simple, lightweight, and user-friendly system that works in real time on ordinary computers.

Challenges

- ✓ Noisy background sound in live recordings
- ✓ Short and informal text
- ✓ Different ways people speak and write
- ✓ There is a need for fast response in real-time mode

SentioNet addresses these challenges by keeping the design simple and efficient.

Existing Systems mostly:

- Works on either text or speech-but not both.
- Are usually offline.
- Live microphone support is not easily provided.
- are complex or require high computational power.

The newly proposed SentioNet:

- Combines text sentiment analysis and speech emotion recognition in one platform.
- Supports three modes:
  - ✓ Text input
  - ✓ Uploaded audio file [3]
  - ✓ Live microphone [2]

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- Shows confidence and probability of predictions
- It was built as a simple and interactive web application (Python + Flask) [3][5].
- It is easy to use for feedback analysis, customer interaction, and learning purposes.

3. METHODOLOGY

3.1 System Overview

SentioNet is a web application with three main modules.

1. Text sentiment module

2. Audio file emotion module

3. Emotion module for a live mic for the backend we chose to write it in Python using the Flask framework. The front end is HTML, CSS and JavaScript so that users can easily interact through the browser.

3.2 Sentiment analysis of text When a user types or pastes in text: • The text is cleaned.

• Use natural language processing (NLP) techniques

• A machine learning or deep learning model, which has been trained, will classify the text as positive, negative or neutral.

• The system also shows the confidence score and probability for each class separately.

3.3 Audio emotion analysis

For both uploaded audio files and live microphone:

• Audio is recorded or loaded.

• Mel-Frequency Cepstral coefficients (MFCC) features were extracted. These features represent the important sound characteristics of speech.

• The MFCC features are given to a trained machine learning model.

• The model predicts the emotion, such as happy, sad, angry, and fear.

• The confidence and probability values are displayed.

Live microphone mode

The system records short segments of speech (a few seconds), extracts feature immediately, and shows the predicted emotion almost in real time.

3.4 Tools and Technologies Used.

• Programming language: Python

• Web framework: Flask

• Frontend: HTML, CSS, JavaScript

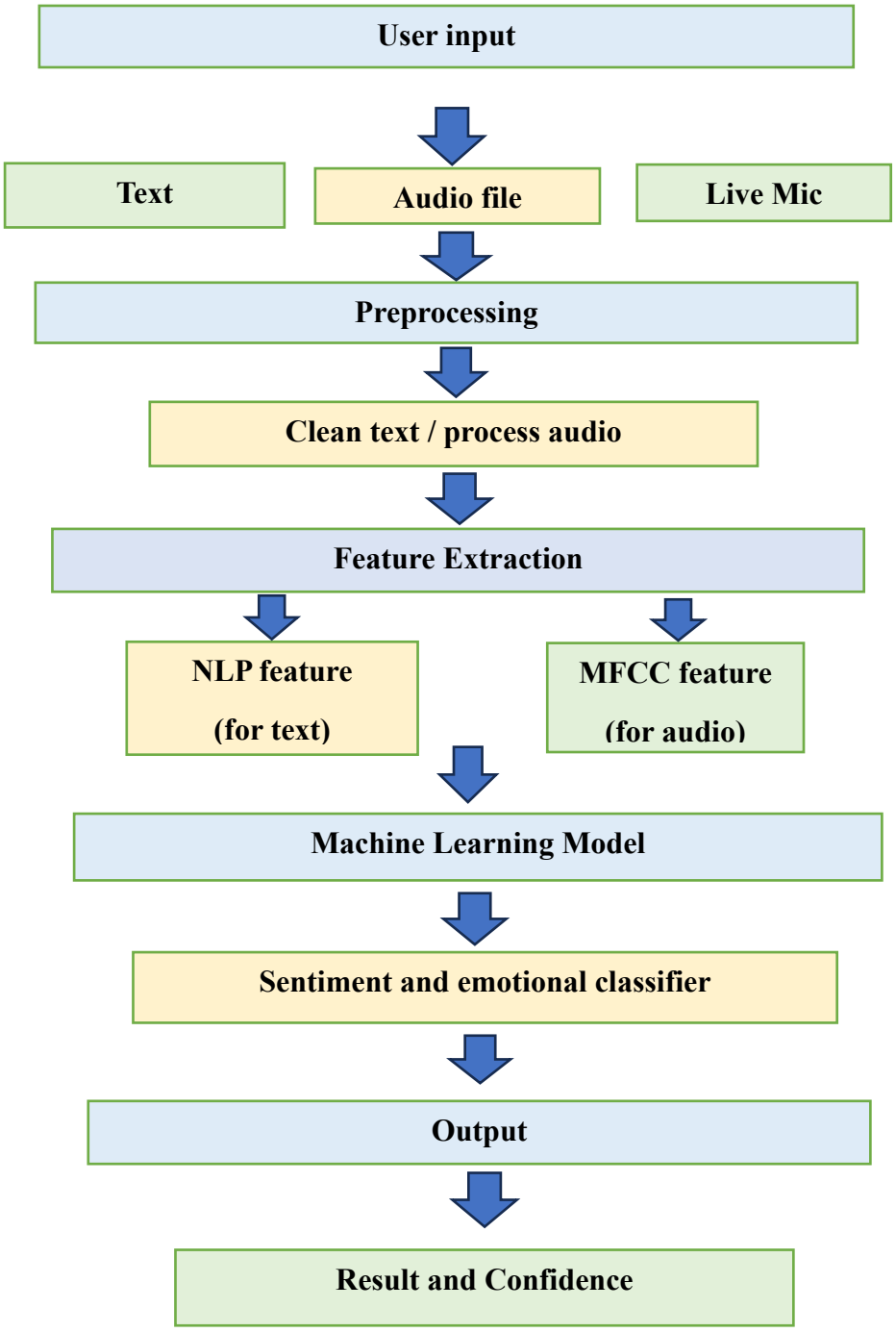
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• Libraries: NLTK for text processing, librosa for audio feature extraction, and scikit-learn or TensorFlow for machine learning models

• Feature: Mel-Frequency Cepstral coefficients (MFCC)

3.5 SentioNet Architecture / work flow



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3.6 Dataset collections

1.Text sentiment analysis

- Training.1600000.processed.noemoticon.csv
- Testdata.manual.2009.06.14.csv
- Train.xlsx and test.xlsx
- Sentiment_dataset.xlsx

These datasets contain text that is positive, negative, or neutral.

A total of 140 dataset was used to train the model.

2. Audio emotion dataset

- Audio_Dataset folder

This folder contains all the emotions, such as happy, sad, angry, neutral, and disgust.

4. RESULTS AND DISCUSSIONS

The proposed SentioNet was tested with a sample demo of audio and text data.

Text sentiment results

This text sentiment analysis correctly classified most positive, negative, or neutral sentences. The text provides clear sentences and provides the confidence to get the results correctly.

Audio emotion results

The MFCC-based model was successful in recognizing the emotions from the given datasets and samples. Performance was good when the recording quality of voices was good and there was less background noise.

Live mode performance

This live microphone provides real-time predictions within 1-2 seconds after speaking. This makes the system more interactive and useful.

Overall, the hybrid of text and speech analysis is easy for the users to understand.

5. COMPARATIVE ANALYSIS

Compared to other systems that only work on text or audio, Sentionet offers three advantages:

- Supports both text and voice on the same website.

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- Works on live microphone.
- It shows confidence and probability values.

6. PRACTICAL IMPLEMENTATION

This approach can be useful in many areas:

- Customer services: analyze the feedback and the complaints
- Education: helps in understanding the emotions in speech and writing
- Human-computer interaction: a user-friendly platform where the interaction is two-way.

7. CONCLUSION

This work presents a simple and interactive web-based application for sentiment and emotion analysis. By combining natural language processing for text and MFCC for audio, the system successfully analyzes the feelings of both written words and spoken voices.

The three modes of text, audio, and live microphone make the platform more flexible and user-friendly for the users. The system provides useful predictions with confidence scores in real time.

8. FUTURE WORK

- We can add more emotional classes.
- Improve the performance of audio in noisy environments.
- Supporting multiple languages.
- Using advanced models for even more accuracy in emotions and sentiments.

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