Real-Time Scream Detection for Women's Safety and Crime Prevention

EmpowerHer

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Problem Statement

Crime is an escalating social issue that poses a significant threat to personal safety, particularly for women. Many incidents, including assaults and harassment, occur in isolated environments where victims may lack immediate means of alerting authorities. The absence of timely police intervention can exacerbate the situation, leading to severe consequences. Current solutions often rely on manual reporting, which can be delayed due to various factors such as the victim's inability to communicate effectively or the absence of witnesses. Thus, there is a pressing need for an innovative solution that can automatically detect distress signals, particularly human screams, and facilitate immediate police response.

Solution

To address this problem, we propose the development of a real-time scream detection and analysis system that utilizes machine learning and deep learning technologies. This system will continuously monitor audio inputs for signs of distress, specifically human screams, and automatically alert the nearest police station with the user's location through SMS. The primary components of the solution include:

1. **Real-Time Detection**: The application will work in the background, analyzing audio input in real time to detect screams amidst background noise.
2. **Machine Learning Models**:
    - **Support Vector Machine (SVM)** will be employed for the initial detection of screams.
    - **Multilayer Perceptrons (MLP)** will serve as a secondary confirmation mechanism to ensure accuracy in identifying screams.
3. **Automated Alert System**: Upon detecting a scream, the application will classify the situation's urgency (high-risk or medium-risk) based on the outputs of both models and automatically send an alert message to the nearest police station, including the user's location for rapid intervention.
4. **User-Friendly Interface**: The application will feature an intuitive user interface developed using the Kivy framework, making it accessible for both desktop and Android users.

Objectives

The primary objectives of this project are:

- To develop a desktop application that detects human screams in real time.
- To analyze detected screams and classify them as potential threats.
- To automatically send alerts to the nearest police station, including the user's location, upon detection of a scream.
- To improve overall societal safety by facilitating timely police intervention in emergency situations.

Tools and Technologies Used

- **Programming Language**: Python
- **User Interface Framework**: Kivy (for desktop and Android compatibility)
- **Machine Learning Algorithm**: Support Vector Machine (SVM) for scream detection
- **Deep Learning Model**: Multilayer Perceptrons (MLP) for confirmation of detected screams
- **Libraries**:
    - **Pandas**: Data manipulation and analysis
    - **NumPy**: Numerical computing
    - **Scikit-learn**: Machine learning
    - **TensorFlow**: Deep learning model training and saving
    - **Librosa**: Audio analysis and feature extraction

Implementation Steps

Step 1: UI Design

The user interface (UI) of the application will be developed using the Kivy framework. The UI will consist of two main screens:

- **Main Screen**: Provides an overview of the application’s functionality and status.
- **Recording Screen**: Displays real-time audio input and processing status.

Step 2: Data Set Preparation for Human Scream Detection

A dataset will be created consisting of two classes:

- **Positive Class**: Approximately 2,000 human scream audio samples.
- **Negative Class**: Approximately 3,000 non-scream audio samples.

Step 3: Extraction of Mel Frequency Cepstral Coefficients (MFCCs)

The next step involves extracting MFCCs from the audio dataset using the Librosa library. These features will be crucial for training the machine learning and deep learning models and will be saved in a CSV file for further processing.

Step 4: Training the SVM Model

The SVM model will be trained on the extracted MFCC features. This model will serve as the primary detector for identifying screams and differentiating them from background noise. Upon successful training, the model will be saved using TensorFlow.

Step 5: Training the Multilayer Perceptron (MLP) Model

Simultaneously, the MLP model will be trained on the same dataset to improve detection accuracy. This model will function as a confirmation system for detected screams. Once trained, the MLP model will also be saved using TensorFlow.

Step 6: Generating Alert Messages

After training both models, the application will test the audio input against both models. Based on their outputs, the system will classify the risk level:

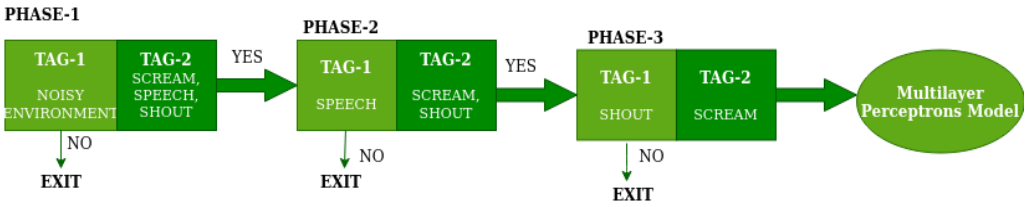
- **High-Risk Alert**: Generated when both models detect a scream.
- **Medium-Risk Alert**: Generated when only one model detects a scream.

Step 7: Sending SMS Alerts to Nearest Police Station

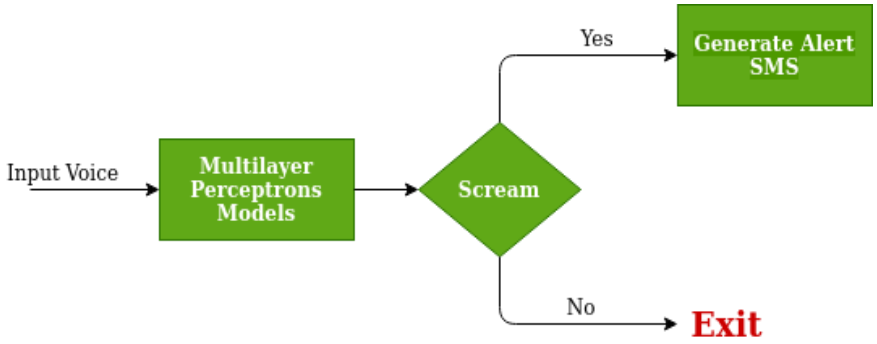
The application will implement a feature to send SMS alerts to the nearest police station upon detection of a scream. This will include the user's location for a swift response. The system will utilize a database of police contacts for efficient communication.

Architecture of the Model:

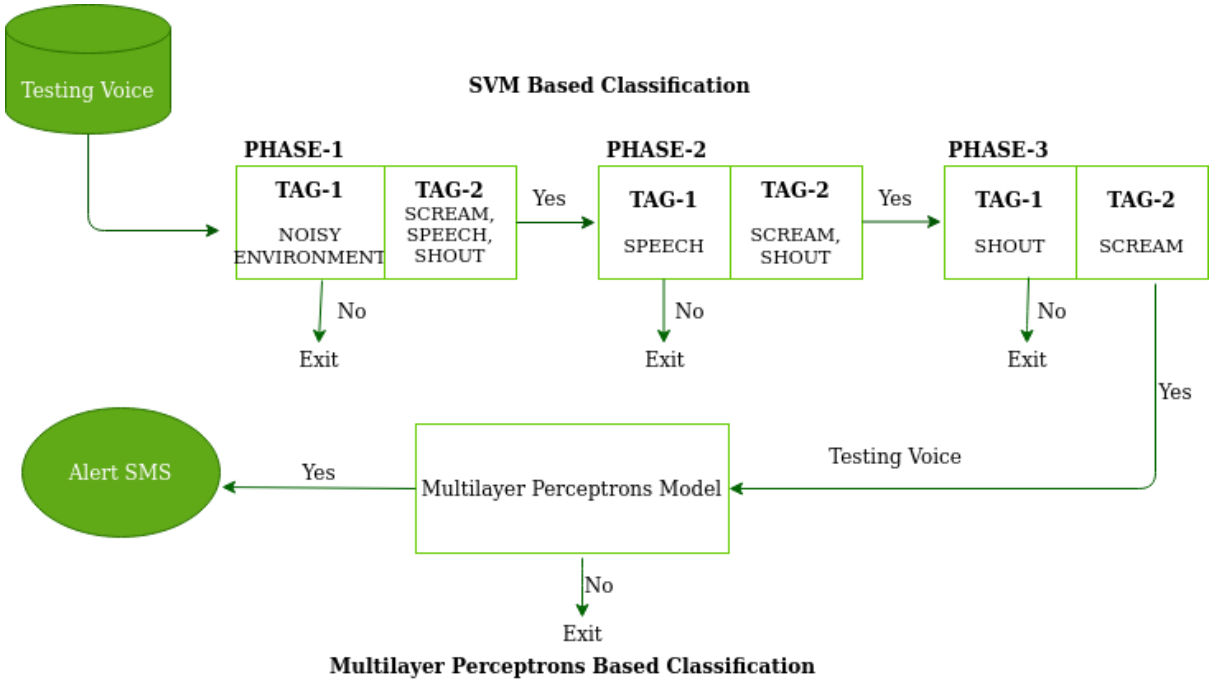
A visual representation of the project's internal workings will illustrate the integration of the SVM and MLP models, showing how audio inputs are processed, classified, and how alerts are generated.



Detection of noise, speech, shout and scream using SVM classifier



Working of MPN

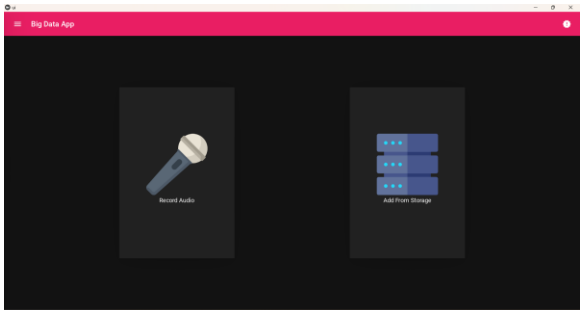


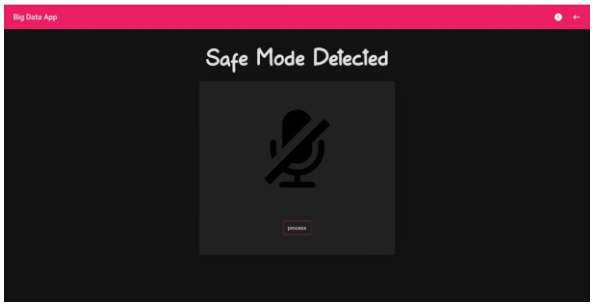
Combined internal working of both models (SVM and MPN)

Real-Life Application

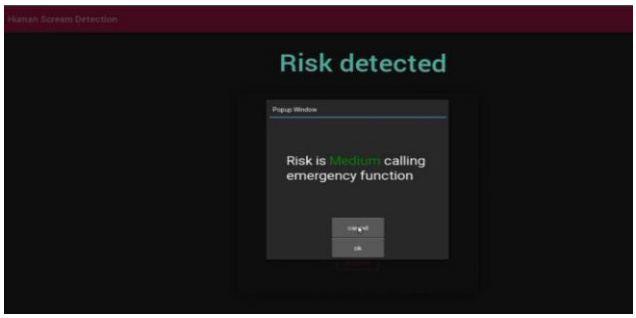
This project is designed to enhance societal safety, particularly for women, by providing a reliable mechanism for detecting distress signals. By facilitating immediate police response, the application aims to reduce crime rates and instill a sense of security among individuals. Moreover, successful implementation could inspire further technological advancements focused on societal safety and crime prevention.

The Desktop Application of the Model are as follows





No sign of Danger



Victim is in Danger

Conclusion

The Real-Time Scream Detection for Women's Safety and Crime Prevention project represents a significant step towards leveraging technology for public safety. Through machine learning and deep learning techniques, this system aims to provide timely assistance in emergencies, ultimately contributing to crime reduction and societal well-being. The potential for future enhancements and applications of this technology can pave the way for smarter, safer communities.