Emotional Recognition

Beginner Project Report submitted in partial fulfillment.

of the requirement for the internship of

Company-Zidio Software Development

Submitted By
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ACKNOWLEGEMENT

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We would like to thank all the staff members who willingly helped us. We are grateful to ZIDIO SOFTWARE DEVELOPMENT 2 MONTH INTERNSHIP for giving us this
opportunity.

The days we have spent in the internship will always be remembered and also be reckoned as guiding in our career.

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Table of Contents

Introduction

Emotional recognition is a groundbreaking field in artificial intelligence focused on enabling machines to understand and interpret human emotions, significantly enhancing human-computer interactions. This technology leverages advanced techniques to analyze data from audio, text, and physiological signals to create systems that respond empathetically and intuitively to users' emotional states.

During my recent project at Zidio Development, I delved into this fascinating area by exploring emotional recognition using Python libraries such as NumPy, Pandas, Librosa, Seaborn, Matplotlib, and Keras. The project involved preparing and cleaning complex audio datasets, extracting crucial features, visualizing patterns, and developing deep learning models to classify emotions from audio signals. The goal was to improve technology's ability to perceive and respond to human emotions, thereby enhancing user experiences, personalizing interactions, and supporting mental health applications. This work underscored the potential of emotional recognition to transform various domains by making technology more responsive and aligned with human emotional needs.

Objectives

- **Data Preparation and Cleaning**:
  - **Address Missing Values**: Identify and impute missing values to ensure the dataset's completeness and reliability.
  - **Normalize Data**: Standardize data to bring all features to a common scale for accurate analysis.
- **Feature Extraction and Visualization**:
  - **Extract Key Features**: Use Librosa to extract essential audio features such as MFCCs and Mel Spectrograms.
  - **Visualize Patterns**: Utilize Seaborn and Matplotlib to create visualizations that reveal patterns and correlations in the data.
- **Model Development and Evaluation**:
  - **Develop Models**: Build and train deep learning models with Keras to classify emotions from audio features.
  - **Evaluate Performance**: Assess model accuracy and effectiveness using metrics like precision, recall, and F1-score.
- **Apply Insights**:
  - **Feature Engineering**: Refine features to enhance emotional classification.
  - **Explore Applications**: Use insights to improve human-computer interactions and mental health tools.

Problem Definition

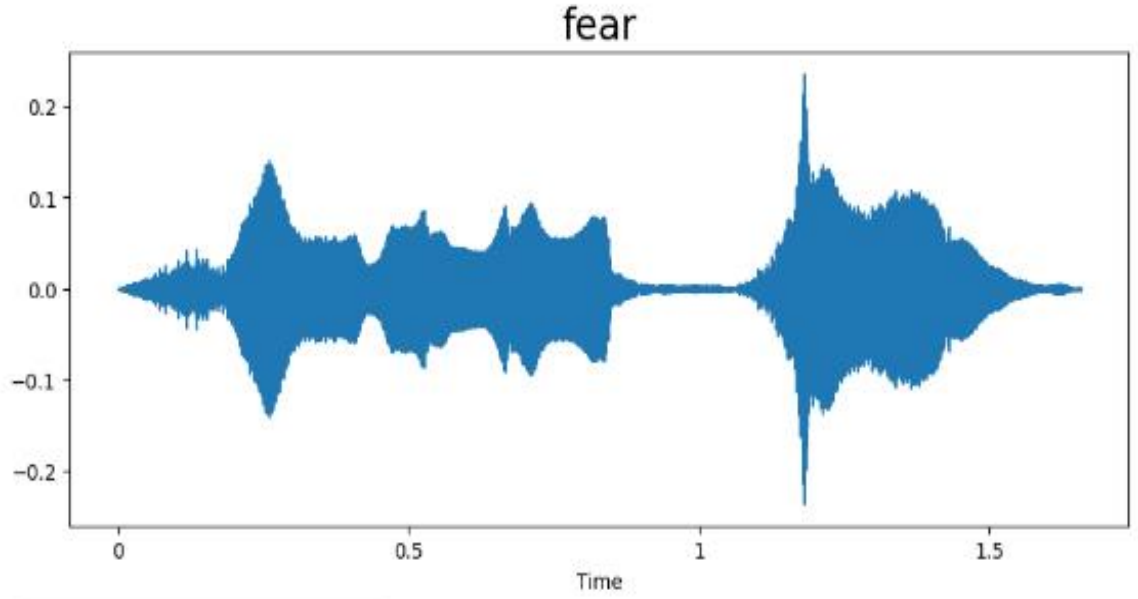
The central challenge of this project is to accurately recognize and classify emotions from audio data, which involves several complex and interrelated tasks:

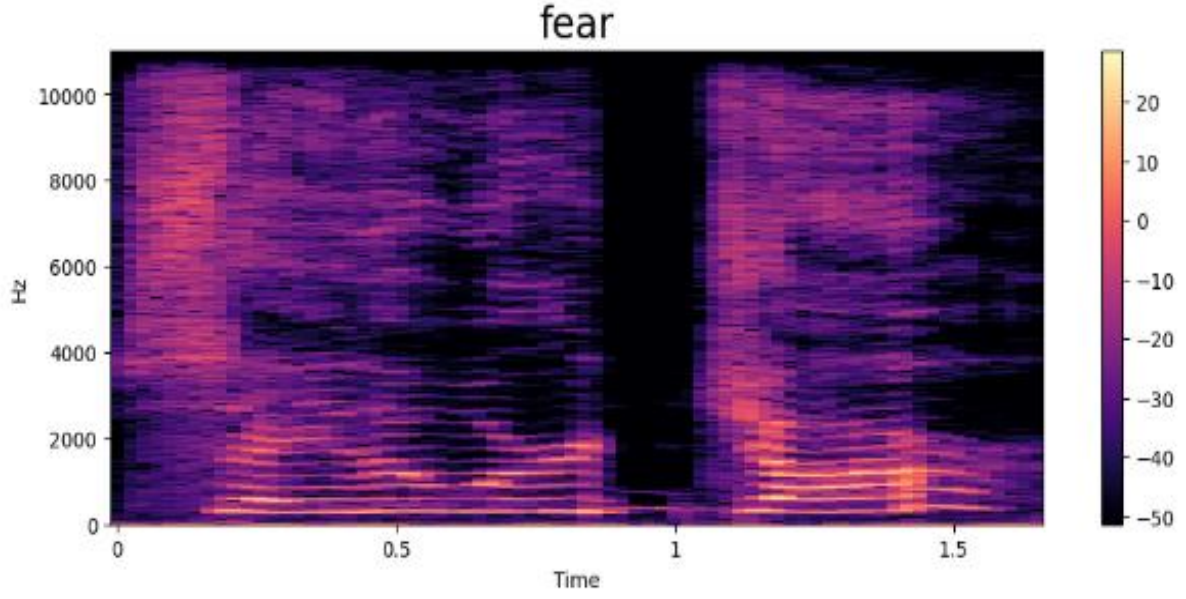
1. **Data Integrity and Preparation**:
    - Ensuring that the audio dataset is complete and free from errors is crucial. This includes addressing issues such as missing values, noise, and inconsistencies that could impact the quality of the analysis and modeling.
2. **Feature Extraction and Relevance**:
    - Extracting meaningful features from audio signals that effectively represent emotional states is a significant challenge. Features such as MFCCs, Chroma, and Mel Spectrograms must be carefully selected and processed to capture the nuances of emotional expression.
3. **Visualization and Interpretation**:
    - Visualizing the extracted features to identify patterns and correlations is essential for understanding how different emotional states are represented in the data. Effective visualization helps in interpreting complex relationships and guiding model development.
4. **Model Development and Accuracy**:
    - Developing deep learning models that can accurately classify emotions based on audio features requires careful design and tuning. Challenges include selecting the right model architecture, optimizing hyperparameters, and ensuring the model performs well across diverse datasets.
5. **Ethical and Practical Considerations**:
    - Implementing emotional recognition systems involves addressing ethical concerns related to privacy, consent, and the potential misuse of emotional data. Ensuring that the technology is used responsibly and maintains user trust is a critical consideration.

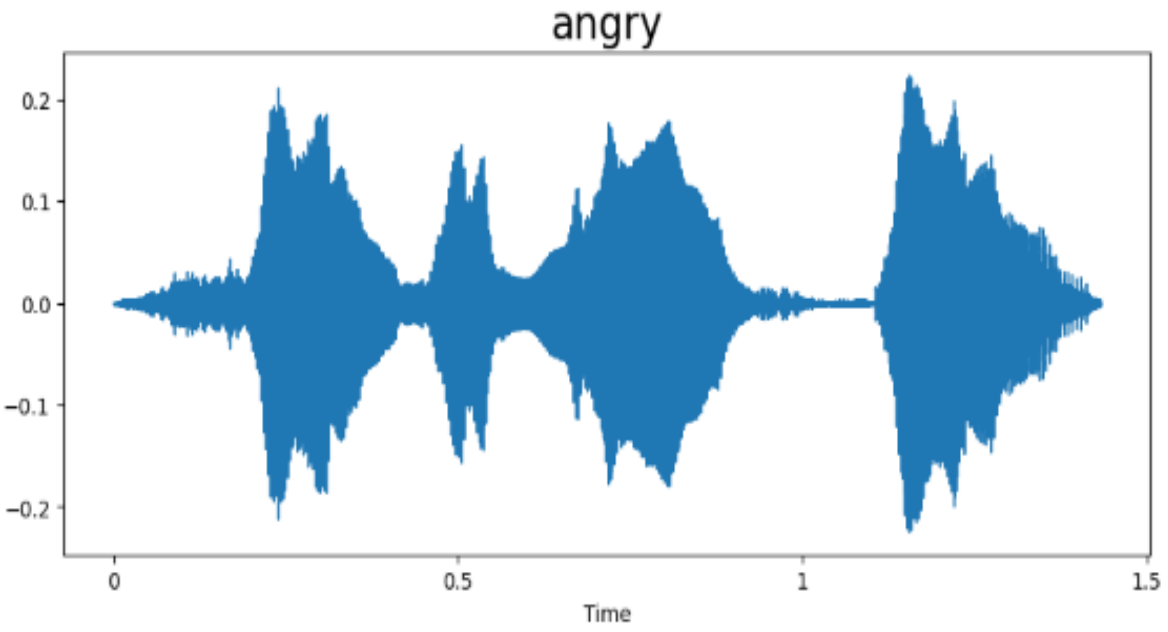
Software Requirements and Tools used

- **Python**:
  - **Version**: Python 3.8
  - **Description**: The main programming language for the project.
- **Libraries and Frameworks**:
  - **NumPy1.20.3**: For numerical computations and array handling.
  - **Pandas1.4.2**: For data manipulation and analysis.
  - **Librosa0.10**: For audio feature extraction.
  - **Seaborn0.11.1**: For advanced data visualization.
  - **Matplotlib3.4.2**: For creating visual plots and charts.
  - **Keras2.12**: For building and training deep learning models (runs on TensorFlow).
- **Development Environment**:
  - **Google Colab**: For writing and executing code in a cloud-based environment.
- **Data Storage**:
  - **CSV Files**: For storing and managing the dataset.
- **Version Control**:
  - **Git**: For tracking code changes and collaboration.
- **Operating System**:
  - **Windows 11**: The operating system used for the project.

Implementation Screenshot Of Emotional Recognition



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0
0.5
1
1.5
Time


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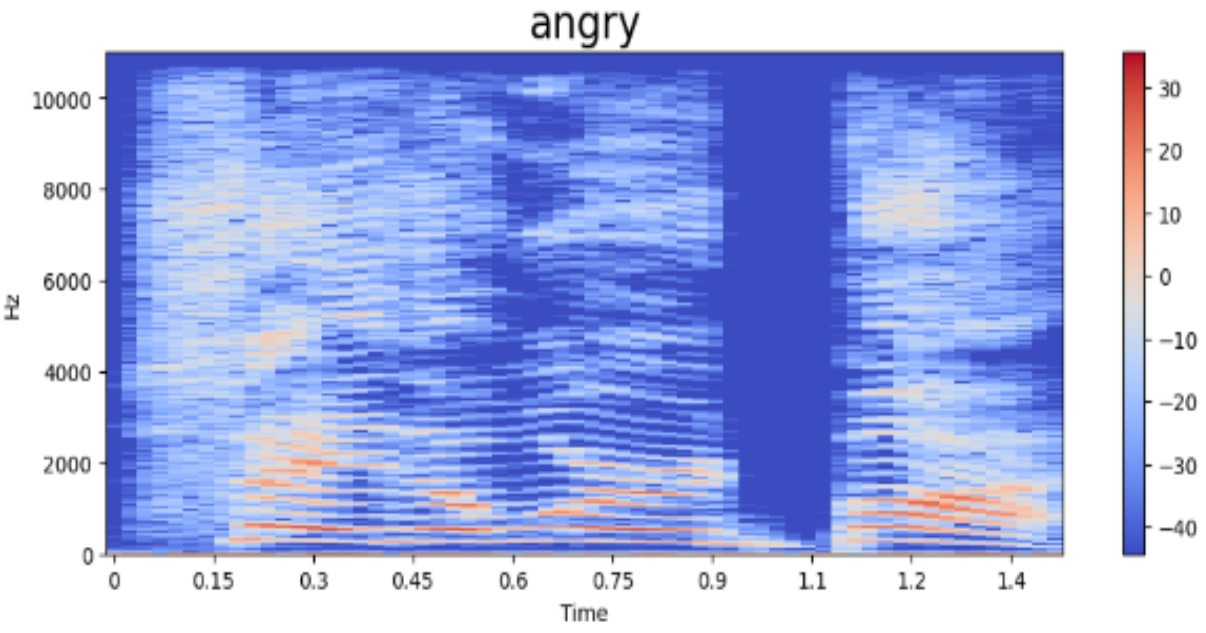
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2000
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1.4
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10
0
−10
−20
−30
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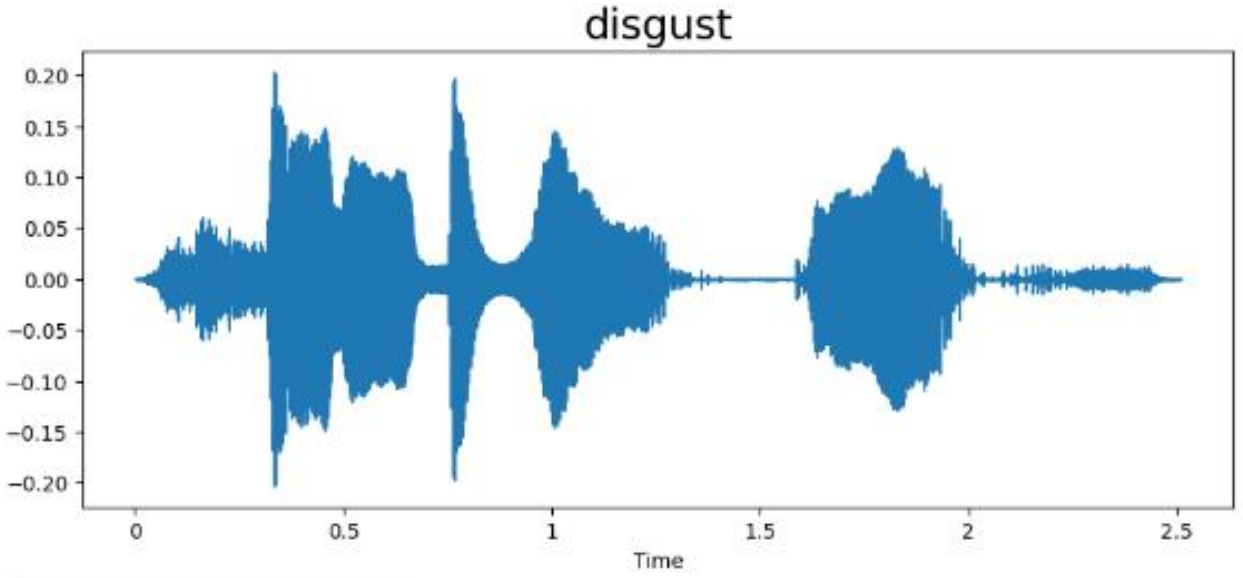
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0.10
0.05
0.00
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0.5
1
1.5
2
2.5
Time


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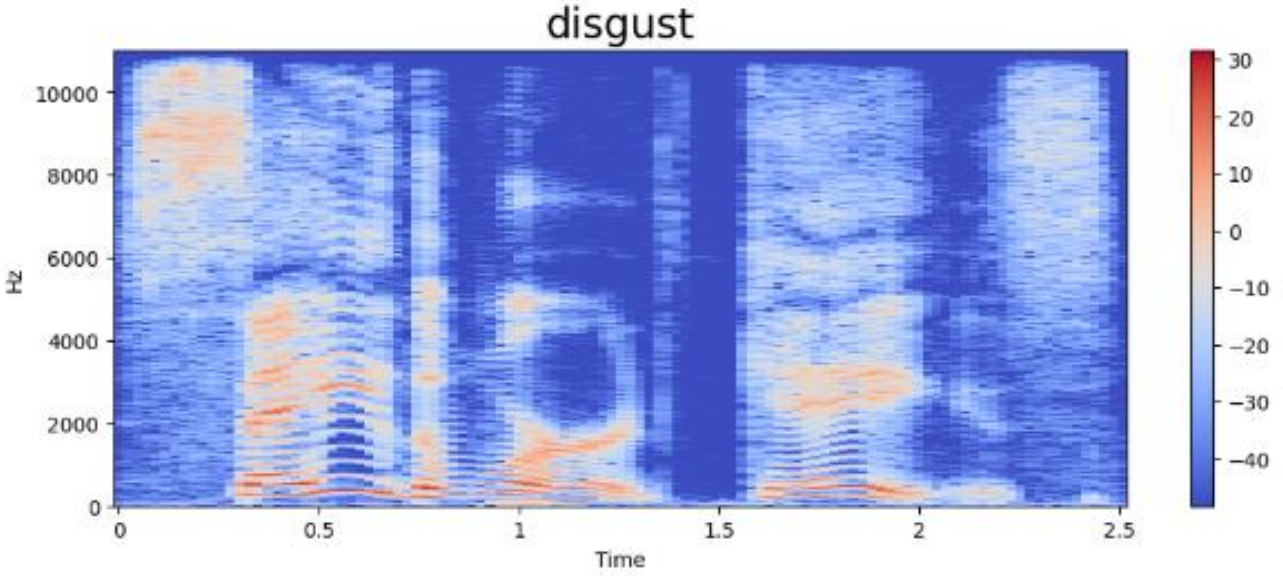
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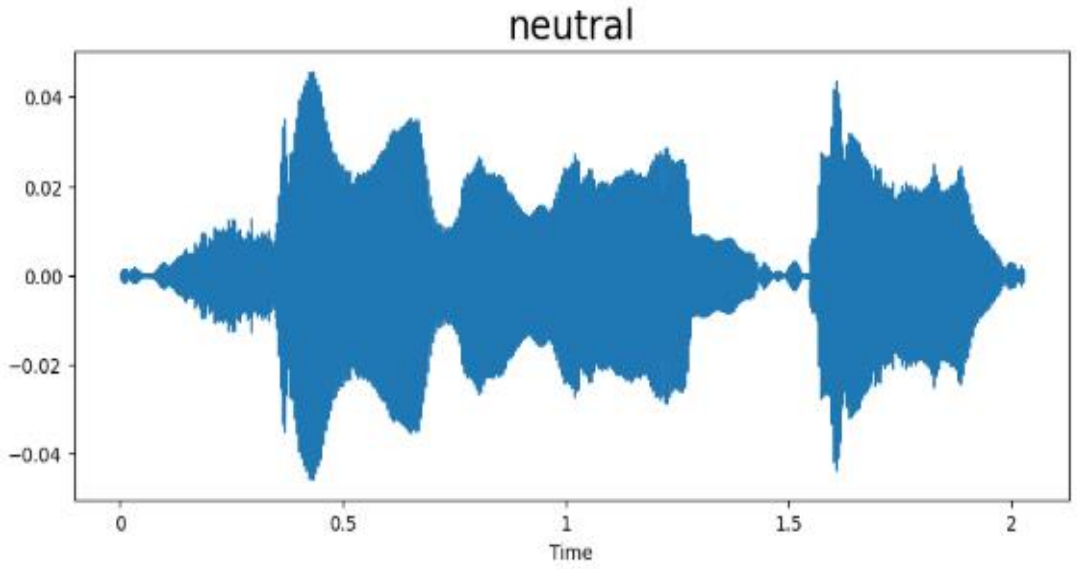
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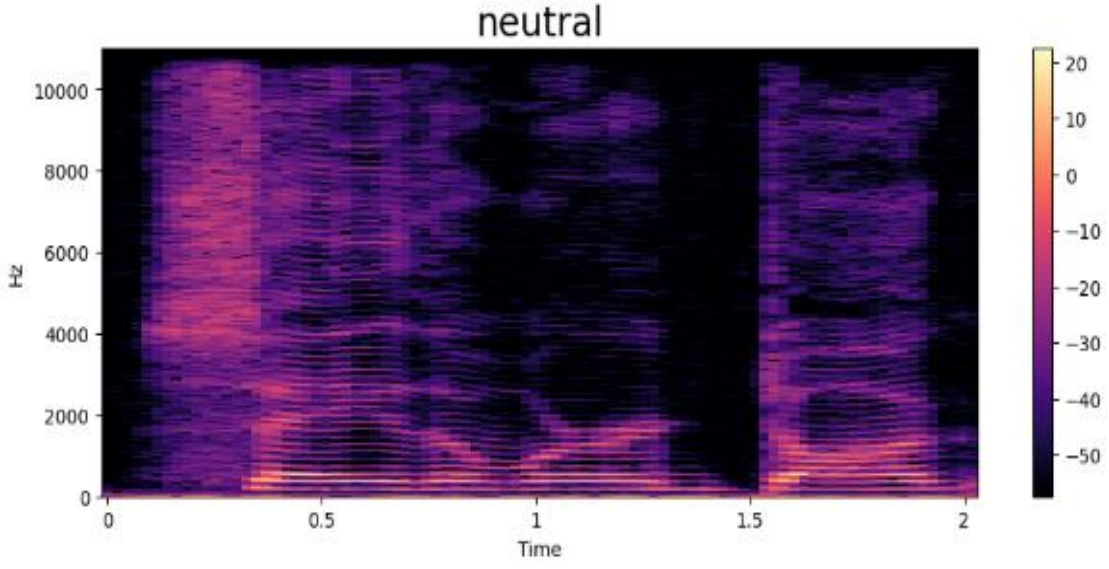
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−30
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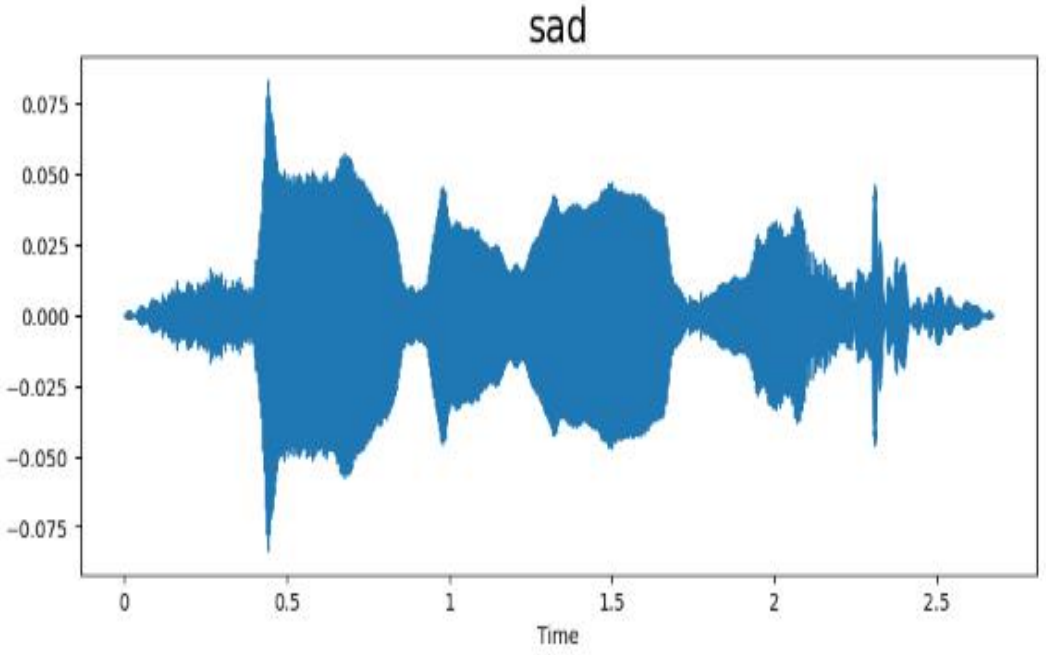
−50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−0.075
0
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1
1.5
2
2.5
Time


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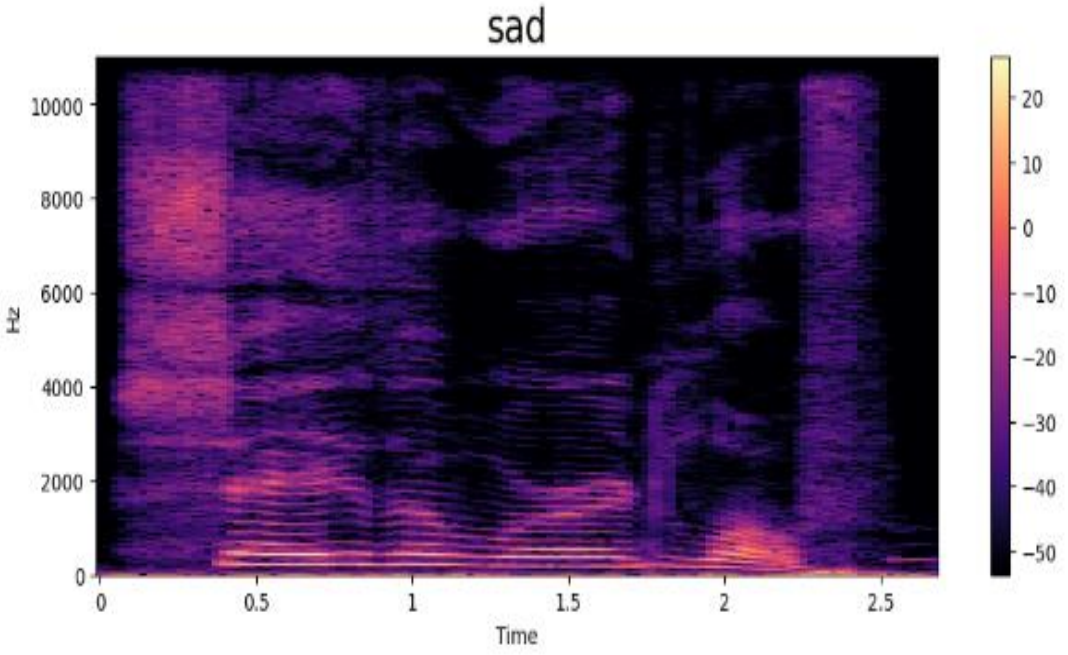
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−40
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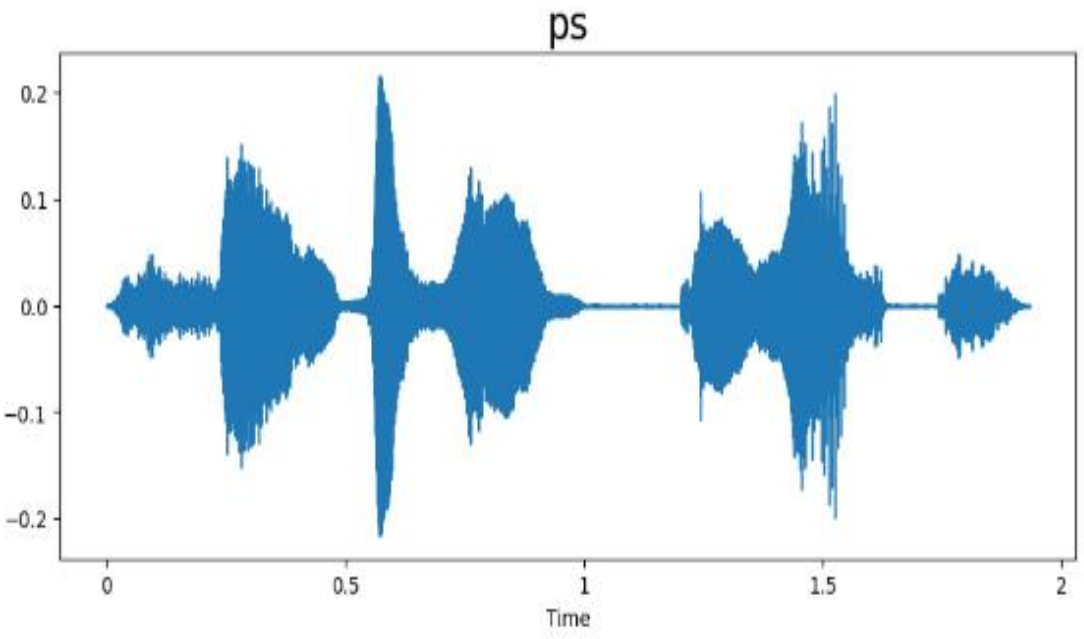
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0.1
0.0
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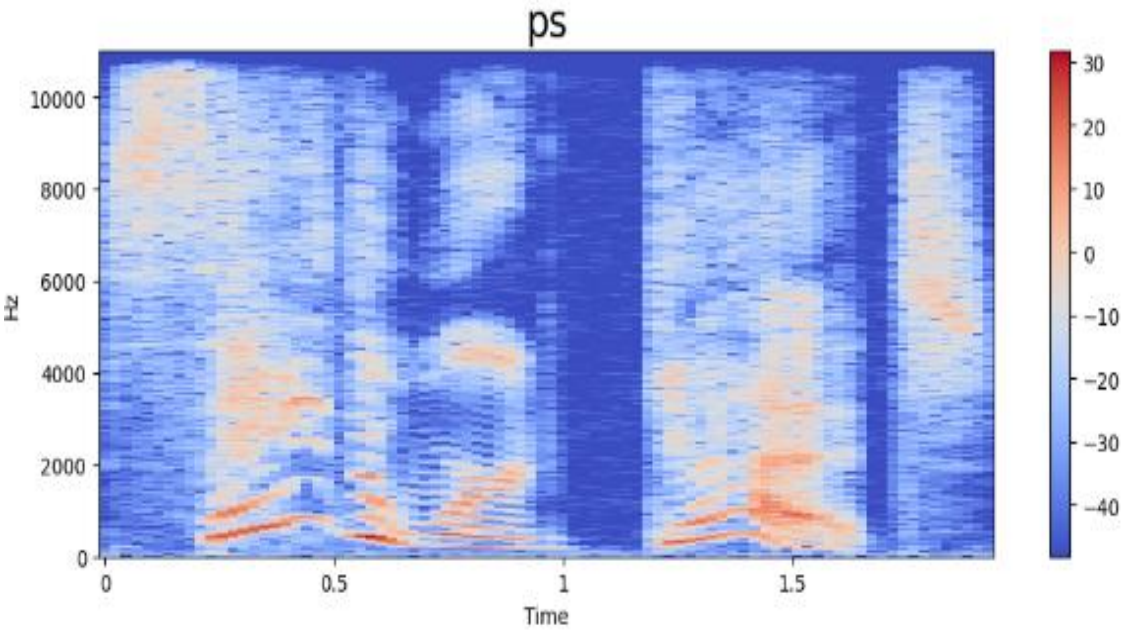
−0.2
0
0.5
1
1.5
2
Time


0:00 / 0:01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10000
8000
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Time
30
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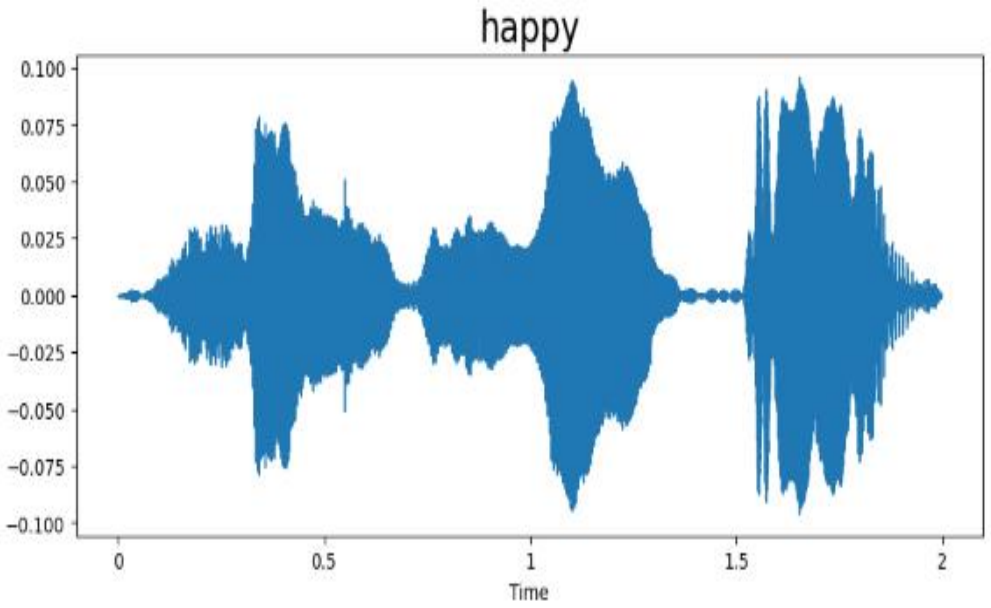
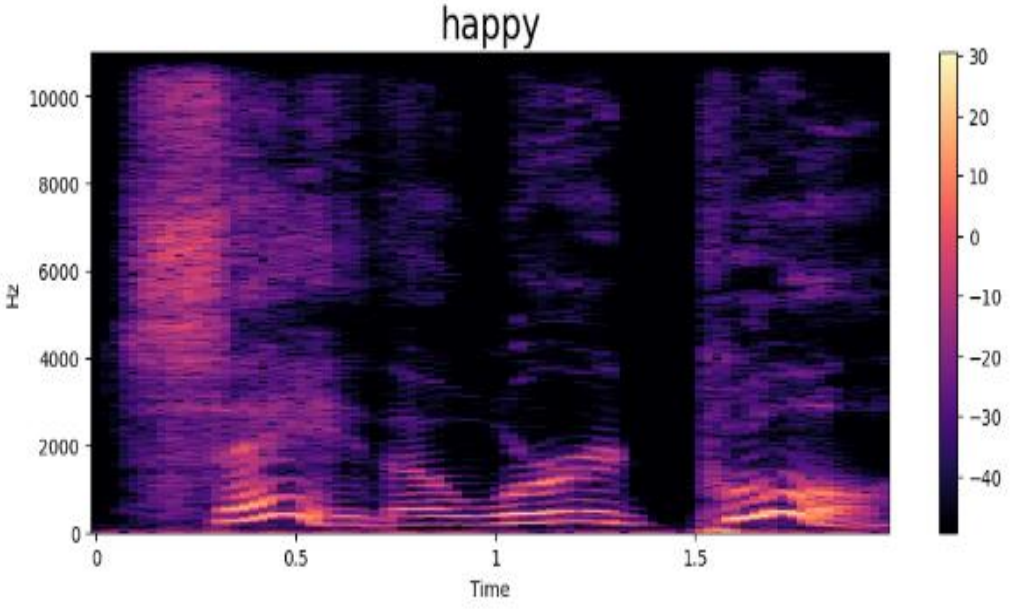
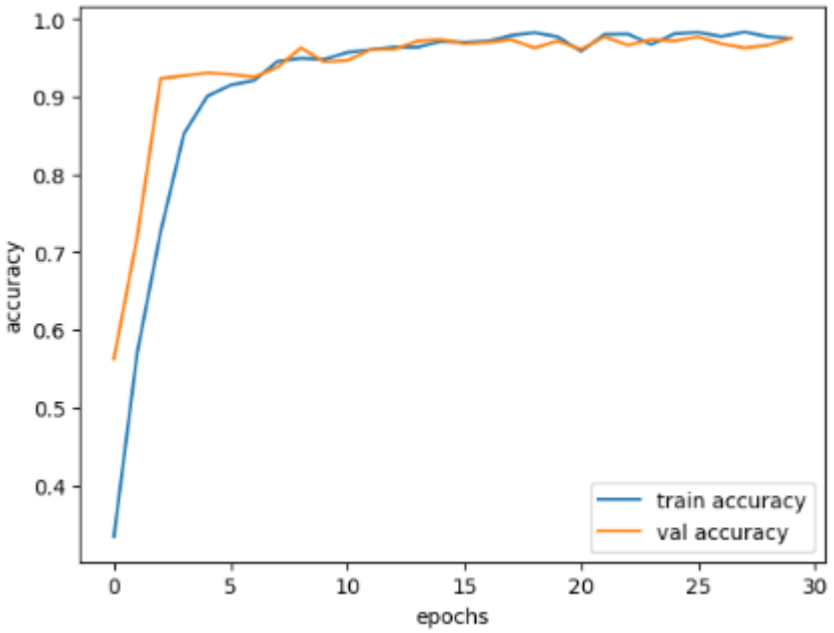
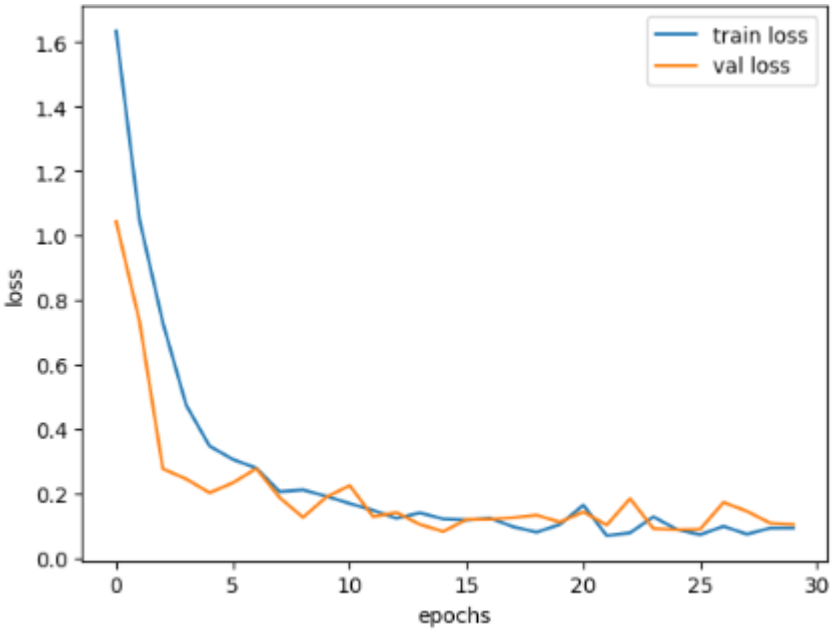
−40


happy
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100
0
0.5
1
1.5
2
Time


0:00 / 0:01


happy
10000
8000
6000
4000
2000
0
Hz
0
0.5
1
1.5
Time
30
20
10
0
−10
−20
−30
−40

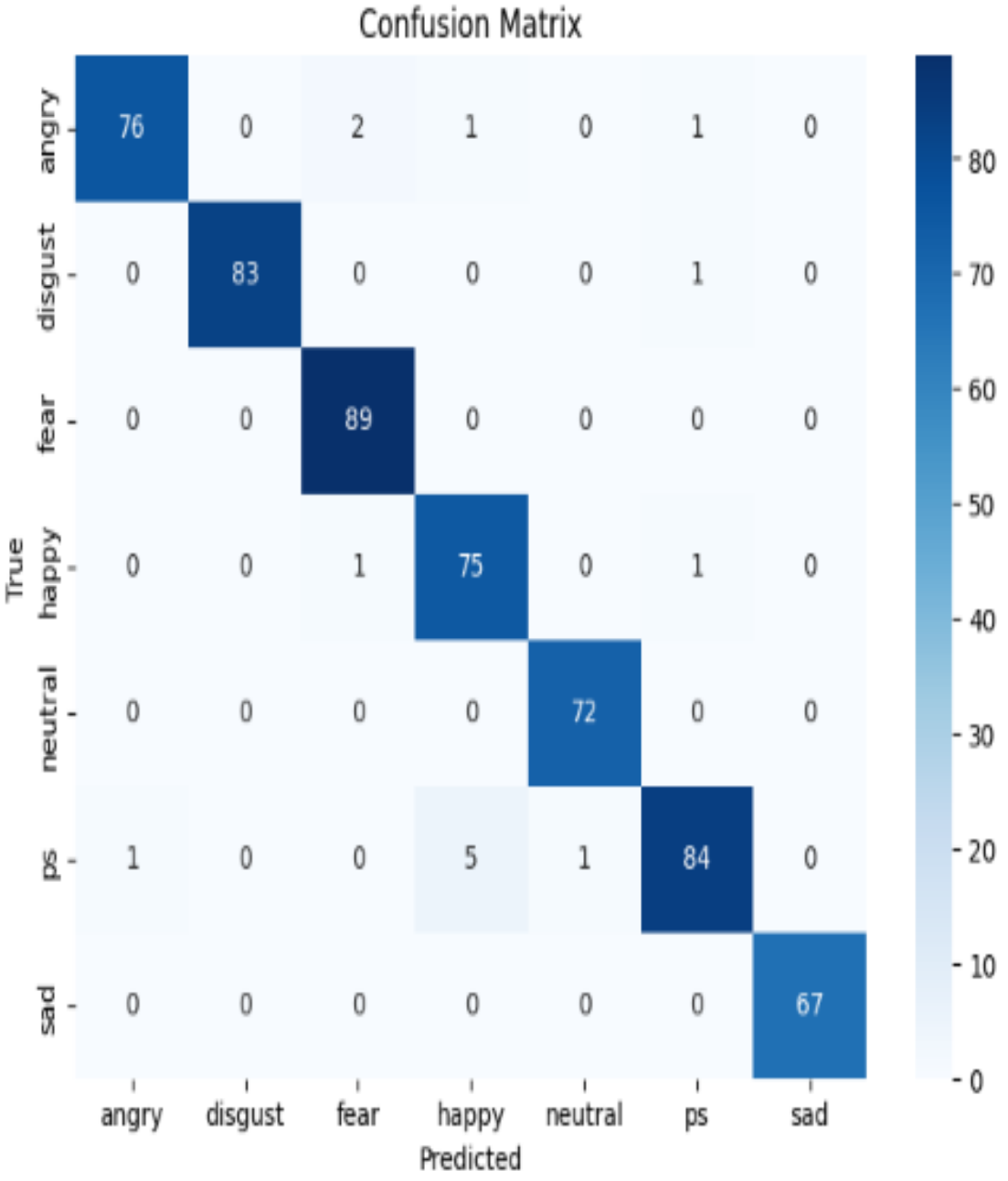





```
Classification Report:
              precision    recall  f1-score   support

       angry       0.99      0.95      0.97        80
     disgust       1.00      0.99      0.99        84
        fear       0.97      1.00      0.98        89
       happy       0.93      0.97      0.95        77
     neutral       0.99      1.00      0.99        72
          ps       0.97      0.92      0.94        91
         sad       1.00      1.00      1.00        67

    accuracy                           0.97       560
   macro avg       0.98      0.98      0.98       560
weighted avg       0.98      0.97      0.97       560
```


Confusion Matrix
True
angry
disgust
fear
happy
neutral
ps
sad
76 0 2 1 0 1 0
0 83 0 0 0 1 0
0 0 89 0 0 0 0
0 0 1 75 0 1 0
0 0 0 0 72 0 0
1 0 0 5 1 84 0
0 0 0 0 0 0 67
angry
disgust
fear
happy
neutral
ps
sad
Predicted
80
70
60
50
40
30
20
10
0

Conclusion and future Scope

Emotional recognition is a transformative field within artificial intelligence that enhances human-computer interactions by making them more intuitive and empathetic. My recent project at Zidio Development focused on exploring this area using Python and libraries such as NumPy, Pandas, Librosa, Seaborn, Matplotlib, and Keras.

Throughout the project, I prepared and cleaned audio datasets, extracted key features like MFCCs and Mel Spectrograms, and visualized patterns critical for emotional recognition. I developed and trained deep learning models with Keras to accurately classify emotions from audio signals.

Key takeaways include the importance of robust data preprocessing, visualization, and the application of machine learning algorithms to classify emotions. These insights are crucial for improving human-computer interactions, personalizing user experiences, and supporting mental health applications.

This project highlighted the potential of emotional recognition to make technology more responsive and aligned with human emotional needs. Moving forward, I am excited to apply these skills to new data science endeavors, leveraging emotional recognition to drive innovation and deliver strategic solutions.

Reference

Github Link - https://github.com/Darshanj229/Emotional-Recognition

THANK YOU