[MUSICAL INSTRUMENT IDENTIFICATION BY USING AUDUIO FEATURES

GITAM
SCHOOL OF TECHNOLOGY
BENGALURU

DEPARTMENT OF EECE
GITAM
SCHOOL OF TECHNOLOGY
BENGALURU

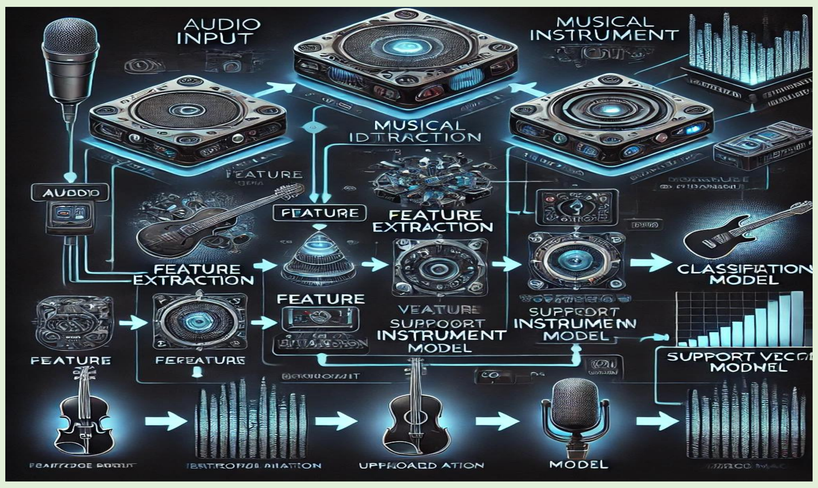
[P.Uday Kumar Raju,C.Rama Karthik,S.Venkata Siva Kumar
Supervisor : << Assistant Professor Chintoo Kumar>>

Abstract

With the growing volume of musical content on social media, efficient retrieval and classification of audio data have become increasingly important. This project focuses on musical instrument identification, a subdomain of music information retrieval (MIR), using an integrated entropy-based feature extraction method. The study employs monophonic recordings of solo instrument performances and extracts temporal, spectral, Mel-Frequency Cepstral Coefficients (MFCCs) .A novel entropy-integrated feature vector is generated for classification, which is then processed using a Support Vector Machine (SVM) and Random Forest classifier. The proposed approach aims to enhance the accuracy of instrument recognition, aiding in applications such as music indexing, recommendation systems, and automatic transcription.

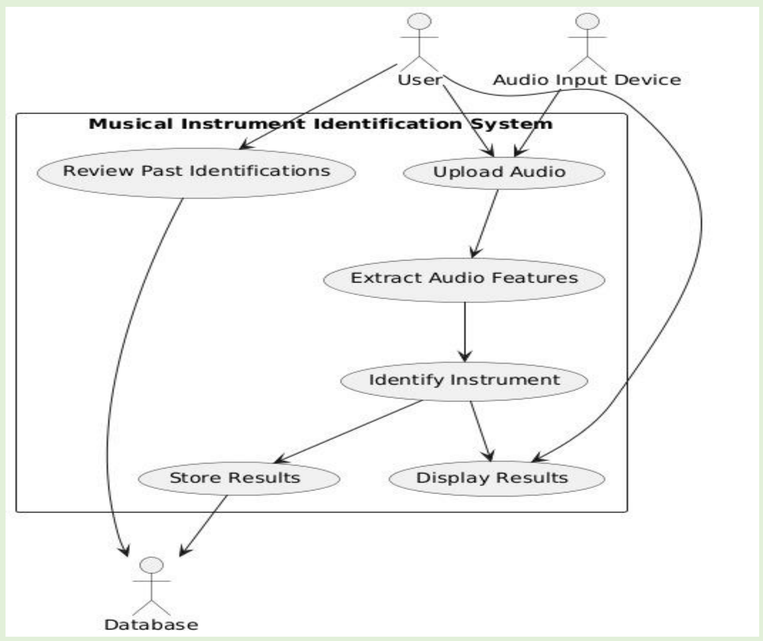
Background

The rapid growth of digital music content has created a demand for efficient music information retrieval (MIR) techniques. One key challenge in MIR is musical instrument identification, which enables better music classification, recommendation, and transcription.
Traditional approaches to instrument classification primarily focused on Western instruments and relied on spectral and timbre-based features. However, recent advancements in machine learning and signal processing have led to more robust techniques that leverage a combination of temporal, spectral, and cepstral features, such as Mel-Frequency Cepstral Coefficients (MFCCs) and Gammatone Frequency Cepstral Coefficients (GFCCs).



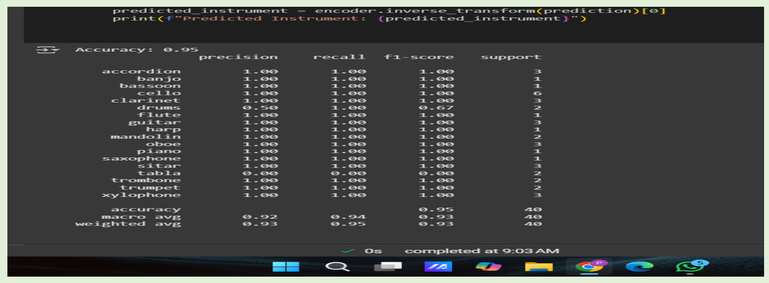
Methods

Audio Collection: Gathered instrument recordings from datasets like IRMAS or recorded manually.
Preprocessing: Resampled audio, removed noise, and normalized sound levels.Feature Extraction: Extracted MFCCs, GFCCs, spectral, and temporal features.
Feature Processing: Used entropy-based selection to refine data.
Classification: Trained an SVM and Random Forest model to identify instruments.
Evaluation: Measured accuracy, precision, recall, and confusion matrix.
Real-Time Identification: Developed a system to classify live or uploaded audio.
Application Development: Created a user-friendly tool with waveform and spectrogram displays.
We used the python programming to complete this project.
We used Gradio for GUI.



Results

The model accurately identified musical instruments.High precision and recall with minimal errors.Most predictions matched the correct instruments.



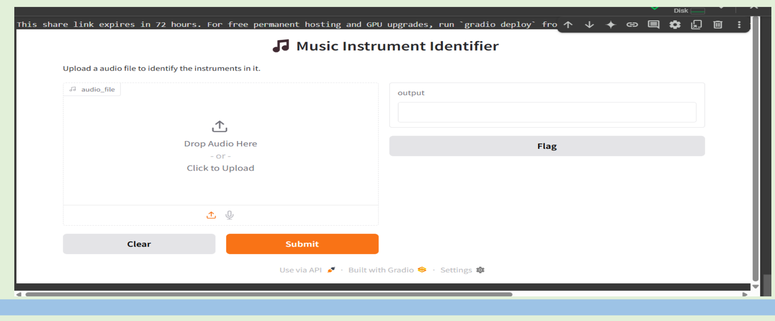
```
predicted_instrument = encoder.inverse_transform(prediction)[0]
print(f"Predicted Instrument: {predicted_instrument}")
```

```
Accuracy: 0.95
              precision    recall  f1-score   support

   accordion       1.00      1.00      1.00         3
       banjo       1.00      1.00      1.00         1
     bassoon       1.00      1.00      1.00         1
       cello       1.00      1.00      1.00         6
    clarinet       1.00      1.00      1.00         3
      drums        0.50      1.00      0.67         2
       flute       1.00      1.00      1.00         1
      guitar       1.00      1.00      1.00         3
        harp       1.00      1.00      1.00         1
    mandolin       1.00      1.00      1.00         2
       organ       1.00      1.00      1.00         1
       piano       1.00      1.00      1.00         1
  saxophone        1.00      1.00      1.00         3
       sitar       1.00      1.00      1.00         1
       tabla       0.00      0.00      0.00         2
    trombone       1.00      1.00      1.00         2
     trumpet       1.00      1.00      1.00         2
  xylophone        1.00      1.00      1.00         3

    accuracy                           0.95        40
   macro avg       0.92      0.94      0.91        40
weighted avg       0.93      0.95      0.93        40
```

0s completed at 9:03 AM



Conclusion

The system successfully identifies musical instruments from audio recordings.
Random Forest and SVM classifier, along with MFCC and GFCC features, improves accuracy.
Entropy-based feature selection enhances performance.
The model works well for both recorded and real-time audio.

Future Perspectives

Deep Learning Integration: Improve classification using CNNs or RNNs for advanced feature learning.
Real-Time Application: Develop a mobile or web-based tool for live instrument recognition.
Noise Handling: Enhance robustness to background noise for real-world performance.
Multi-Instrument Recognition: Enable detection of multiple instruments in a single audio file.

Impact on Society

Music Education: Helps students and musicians analyze and identify instruments easily..
Cultural Preservation: Aids in recognizing and archiving traditional musical instruments.
Enhanced Music Streaming: Improves recommendations by identifying instruments in songs.
Assistive Technology: Supports visually impaired individuals in understanding musical compositions.

To know more

GitHub link:
Video link:

insert your QR code here