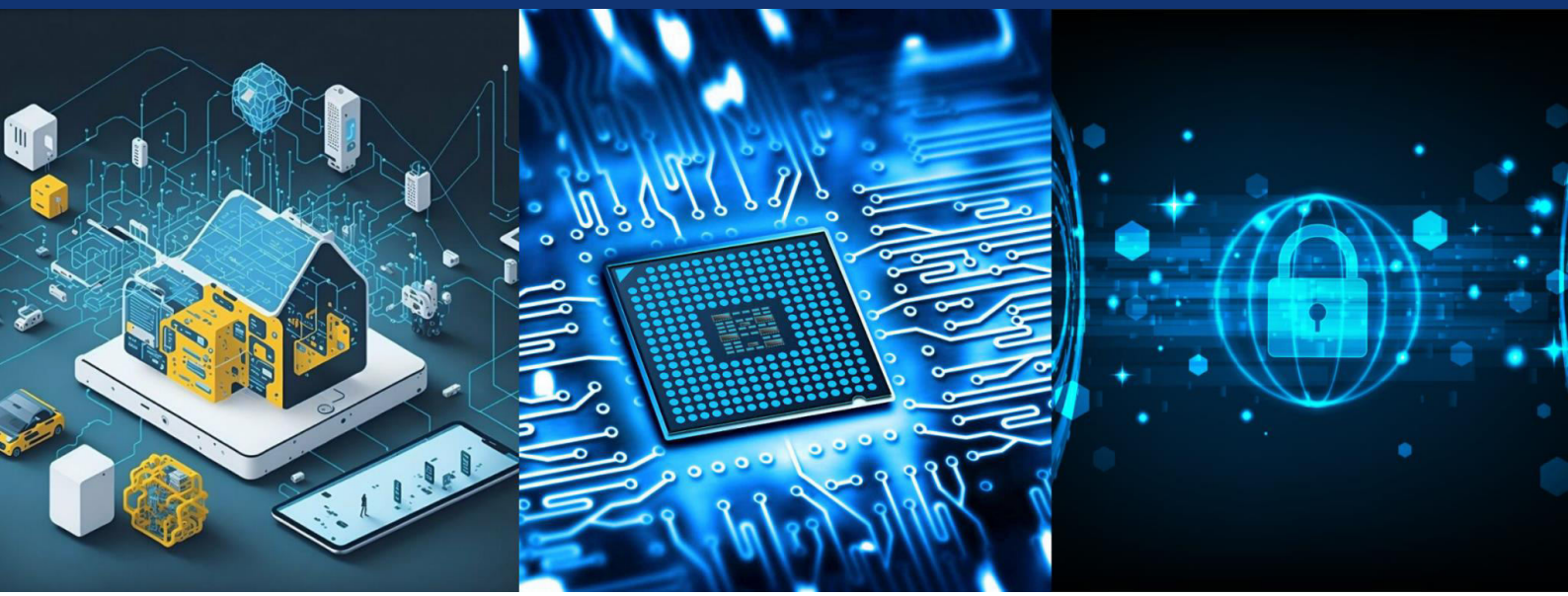
IJIRCCE

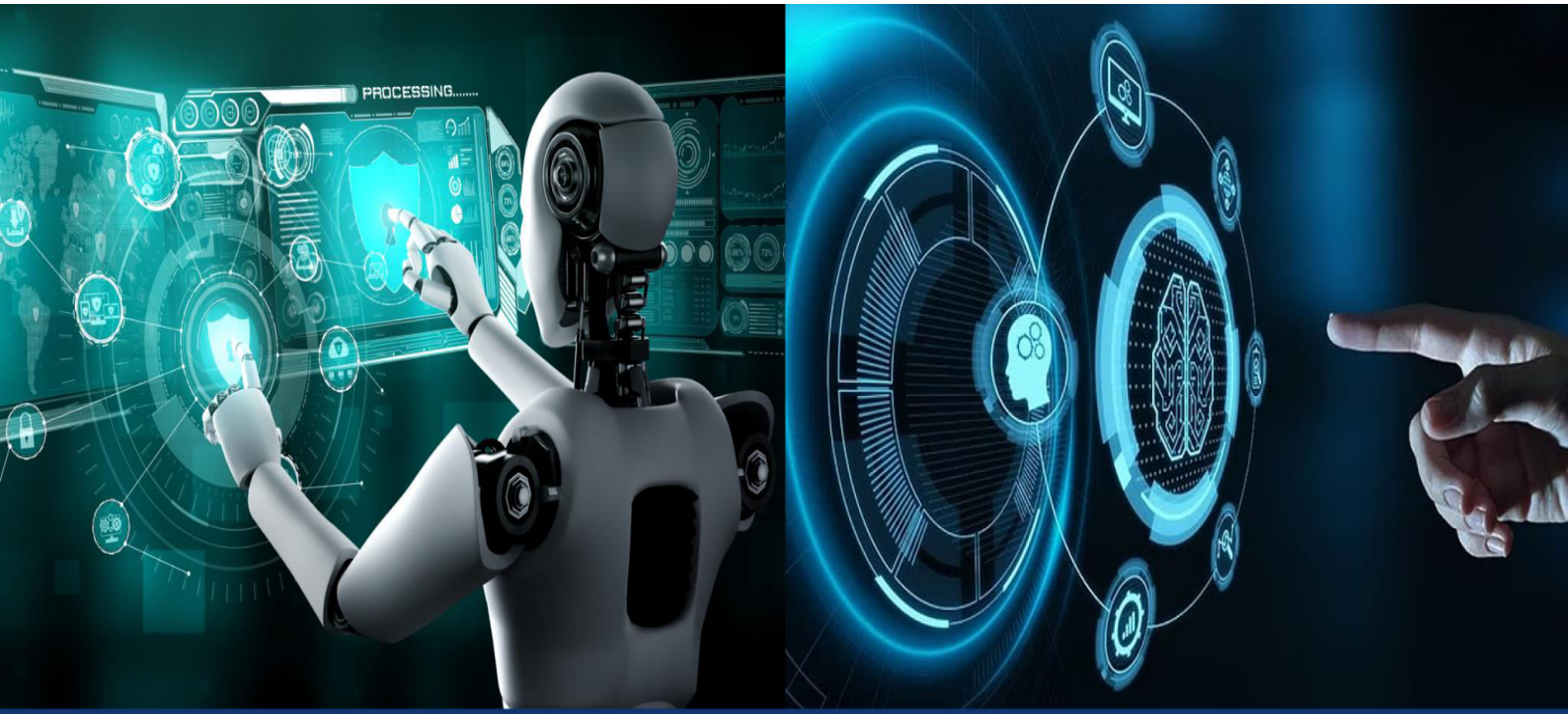
ISSN(O): 2320-9801

ISSN(P): 2320-9798



International Journal of Innovative Research in Computer and Communication Engineering

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.771

Volume 13, Issue 3, March 2025

© 2025 IJIRCCE | Volume 13, Issue 3, March 2025| DOI: 10.15680/IJIRCCE.2025.1303124

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Classify Song Genres from Audio Data

Kavyashree E D[1], Inchara K S[2], Joshitha A[3], Nandita[4], Khwaja Adnan Hussain[5]

Assistant Professor, Department of Computer Science and Engineering, Student of ATME College of Engineering, Mysore, India[1]

Department of Computer Science and Engineering, Student of ATME College of Engineering, Mysore, India[2,3,4,5]

ABSTRACT: Music genre classification plays a crucial role in managing and organizing large-scale. music libraries, offering personalized user experiences, and enabling efficient music retrieval systems. Traditional classification methods, relying heavily on metadata, are prone to inconsistencies, subjective biases, and scalability issues. This project proposes an automated music genre classification system based on intrinsic audio data using advanced feature extraction techniques and machine learning algorithms. The system extracts key audio features such as Mel-Frequency Cepstral Coefficients (MFCCs), chroma features, spectral centroid, tempo, and rhythmic patterns to represent the unique characteristics of songs. Machine learning and deep learning models, including Support Vector Machines (SVM). k-Nearest Neighbors (k-NN), and Convolutional Neural Networks (CNNs), are employed for genre prediction. The modular framework ensures scalability, adaptability to new genres, and seamless integration with large datasets and diverse applications. This project represents a significant step toward a robust, scalable, and intelligent music genre classification system.

KEYWORDS: k-Nearest Neighbors (KNN), Mel-Frequency Cepstral Coefficients (MFCCs), Spectral Features, Adaptive Learning, Audio Data Analysis,Django

I. INTRODUCTION

Machine learning has revolutionized various industries, including music, by automating tasks that traditionally required human input. One such task is classifying music into genres, which plays a crucial role in organizing vast music libraries, enhancing user experience, and improving recommendation systems. In the past, genre classification was primarily a subjective process, relying on human perception and interpretation of a song's style, mood, and instrumentation. However, with advancements in machine learning, automated systems can now provide a more consistent and data-driven approach to classifying music genres.

Music genre classification involves analyzing the audio data from songs and extracting meaningful patterns that differentiate one genre from another. Songs exhibit distinct characteristics such as tempo, pitch, timbre, rhythm, and melody, which can be used as features for classification. Machine learning algorithms process these audio features to identify genre-specific patterns, enabling them to categorize new songs accurately. Various approaches have been explored for this task, ranging from traditional machine learning models like k-Nearest Neighbors (k-NN) to more complex deep learning techniques such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs).

Among these methods, k-Nearest Neighbors (k-NN) is a simple yet effective algorithm for music genre classification. k-NN is a non-parametric, instance-based learning algorithm that classifies new data points based on their similarity to previously labeled examples. In the context of music genre classification, k-NN utilizes feature vectors extracted from audio signals, such as Mel-Frequency Cepstral Coefficients (MFCCs), chroma features, and spectral contrast, to determine the genre of a given song. The algorithm computes the distance between the feature vector of a new song and those of existing songs in a labeled dataset, assigning the genre of the majority of its nearest neighbors.

Despite its simplicity, k-NN has several advantages in music classification. It requires minimal training time, making it suitable for applications where real-time classification is needed. Additionally, it performs well when the dataset is relatively small and well-distributed. However, k-NN also has limitations, such as high computational costs for large datasets and sensitivity to the choice of distance metric and the number of neighbors (k). Proper feature selection and

© 2025 IJIRCCE | Volume 13, Issue 3, March 2025| DOI: 10.15680/IJIRCCE.2025.1303124

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

preprocessing techniques, including dimensionality reduction methods like Principal Component Analysis (PCA), can improve the efficiency and accuracy of k-NN in music classification.

One of the key challenges in music genre classification is the overlap between genres. Many songs exhibit characteristics of multiple genres, making it difficult to assign a single label. Additionally, variations in production quality, instrumentation, and cultural influences can add complexity to classification. To address these challenges, feature engineering plays a vital role in enhancing the effectiveness of machine learning models. Selecting the most relevant audio features and normalizing data can significantly impact classification performance.

Overall, machine learning, and specifically the k-NN algorithm, offers a promising approach to automating music genre classification. By leveraging the inherent patterns in audio data, k-NN provides a straightforward yet powerful method for categorizing songs, contributing to more efficient music management, personalized recommendations, and enhanced user experiences. As technology advances, integrating hybrid models and improving feature extraction techniques will further refine the accuracy and robustness of music genre classification systems.

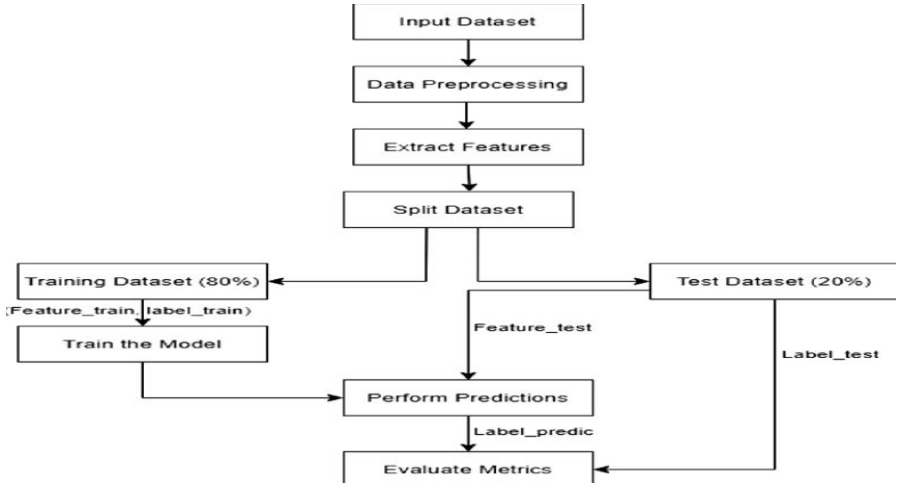


Fig 1.A general flow diagram describing the classification and prediction process

II. RELATED WORK

[1]Music Genre Classification Using Advanced Audio Analysis and Deep Learning Techniques • Author: Mumtahina Ahmed Publication Year: September 2024 This paper demonstrates the efficacy of convolutional neural networks by classifying music genres with an impressive 92.7% accuracy.The study recognizes the intricacy of music genre classification and the necessity for more investigation.Future research is broadening its scope and concentrating on other aspects of audio, such as spectral quality, rhythmic patterns, and lyric analysis. In order to improve ac curacy and capture a variety of genre features, complex model architectures are used, which include ensemble learning and attention procedures.

[2] "Music Genre Classification based on VMDIWOA-XGBOOST" Authors: Rumeijiang Gan, Tichen Huang, Jin Shao, and Fuyu Wang (2024) This research introduces a hybrid model for music genre classification, integrating Variational Mode Decomposition (VMD), Improved Whale Optimization Algorithm (IWOA), and Extreme Gradient Boosting (XGBOOST). The study focuses on enhancing classification accuracy by optimizing model parameters through IWOA and leveraging VMD for advanced feature extraction. Using the GTZAN and Bangla datasets, the proposed approach outperforms traditional classification methods, demonstrating improved accuracy and robustness. The findings emphasize the effectiveness of hybrid optimization techniques in refining genre classification models.

[3] "A study on music genre classification using Machine Learning" Authors: Partha Ghosh, Soham Mahapatra, Subhadeep Jana, and Ritesh Kr. Jha (2023) This study examines various machine learning models for genre classification using the Free Music Archive (FMA) dataset. The models tested include Support Vector Classifier (46%

accuracy), Logistic Regression (40%), Artificial Neural Networks (67%), Convolutional Neural Networks (77%), and Convolution-Recurrent Neural Networks (90%). The results indicate that a combination of CNN and RNN architectures yields the highest classification accuracy. Additionally, ensemble techniques like AdaBoost further improve performance, achieving up to 85% accuracy. The study highlights the potential of deep learning models in automating and enhancing music genre classification tasks.

[4] "BMNet-5: A Neural Network Approach for Bengali Music Genre Classification" Author: Khan MD Hasib (2022) This research introduces BMNet-5, a neural network-based model designed to classify Bengali music genres, including Bangla Adhunik, Bangla Hip-Hop, Bangla Band Music, Nazrulgeeti,Palligeeti, and Rabindra Sangeet. The study utilizes a dataset of 1,742 Bangla music compositions, applying feature extraction techniques to achieve automatic genre classification. BMNet-5 outperforms previous models, achieving a classification accuracy of 90.32%. The model's stability is further validated using K-fold cross-validation with varying k values.

[5] "Large-Scale Music Genre Classification Using Machine Learning and Apache Spark"Authors: Mousumi Chaudhury (2022) This study explores an ensemble-based approach to music genre classification, utilizing Random Forest and the Apache Spark framework to enhance efficiency. By analyzing statistical features from large datasets such as GTZAN, the research compares multiple machine learning techniques, including Naïve Bayes, Decision Trees, and Random Forest, with the latter achieving superior results. The study highlights the advantages of parallel processing in reducing computational costs, particularly for large-scale datasets, and emphasizes importance of optimizing classification performance in big data applications.

[6] "Music Genre Classification Using Support Vector Machines" Authors: J. Li, Y. Song, M. Li (2022) This study investigates the effectiveness of Support Vector Machines (SVM) in music genre classification, leveraging the GTZAN dataset for evaluation.), Feature extraction techniques such as Mel-Frequency Cepstral Coefficients (MFCC) and chroma features are applied to enhance classification performance. The research compares SVM with Decision Trees and Random Forest, demonstrating that SVM achieves an accuracy of 87%, making it a robust model for genre differentiation. The paper also highlights the importance of feature engineering in refining SVM's classification capabilities and discusses potential improvements for real-time music categorization.

[7] Machine Learning-Based Music Genre Classification with Pre-Processed Feature Analysis Author: Md Shofiqul Islam, Md Monirul Hasan, Md Abdur Rahim, Ali Mattleb Hasan, Mohammad Mynuddin, Imran Khandokar, Md Jabbarul Islam.Publication Year: December 2021This paper presents a study on music genre classification using machine learning models, with a focus on pre-processed feature analysis. The authors highlight the challenges of music classification due to the large volume of music generated daily and the complexities in genre differentiation. Using the GTZAN dataset, which includes audio tracks from ten different genres, the study explores multiple machine learning models, including Naive Bayes, Stochastic Gradient Descent, KNN, Decision Trees, Random Forest, SVM, Logistic Regression, Neural Networks, and XGBoost.The paper also emphasizes the role of data filtering in improving classification accuracy and offers insights for future research in real-time music genre recognition.

[8] Music Genre Classification Using Support Vector Machines and Empirical Mode Decomposition Author: Eamin Chaudary Publication Year: July 2021 This paper investigates the application of Support Vector Machines (SVM) combined with Empirical Mode Decomposition (EMD) for music genre classification. By utilizing the GTZAN dataset and extracting features like MFCC, the study achieved 94% classification accuracy.The approach enhances genre recognition by separating intrinsic mode functions (IMFs) from audio signals, improving the model's ability to handle non-linear data.The study highlights the effectiveness of this method over traditional classifiers.

III. PROPOSED ALGORITHM

A. *Design Considerations:*

- Implement secure login, role-based access, and password hashing.
- Provide dashboards for users to track history and admins to monitor activity.
- Optimize loading for speed and scalability.
- Optimize feature extraction (MFCCs) and normalization for faster model training.
- Ensure seamless Django-based UI for real-time predictions and user interaction.

© 2025 IJIRCCE | Volume 13, Issue 3, March 2025| DOI: 10.15680/IJIRCCE.2025.1303124

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

B. *Description of the Proposed Algorithm:*

The proposed system utilizes deep learning models, specifically Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), to analyze raw audio data. By leveraging CNNs for feature extraction and RNNs for temporal analysis, the system efficiently classifies music genres. The system preprocesses raw audio by converting it into spectrograms or Mel-Frequency Cepstral Coefficients (MFCCs) and normalizing the data to improve generalization. CNNs extract spectral and harmonic features such as pitch, timbre, and tonal components, while RNNs (LSTMs/GRUs) analyze rhythmic and temporal dependencies. A hybrid CNN-RNN model is then used for classification, employing the Softmax activation function for multi-class genre prediction. The model outputs probability scores for each genre, selecting the one with the highest probability as the predicted genre. The classified genre is then used to enhance music recommendation systems and seamlessly integrate with streaming platforms.

To ensure optimal performance, the system follows specific selection criteria. CNNs are chosen for their high accuracy in spectral feature extraction and ability to generalize across diverse audio inputs, while RNNs excel at capturing sequential dependencies and rhythmic variations. The Softmax activation function is employed for multi-class classification, with ReLU used for hidden layers. The model is trained using the categorical cross-entropy loss function and optimized using the Adam optimizer for efficient convergence.

The prediction score for each genre is computed using the Softmax function, ensuring accurate and reliable genre classification. This system effectively improves music classification accuracy, making it ideal for real-world applications in streaming services and digital music libraries.

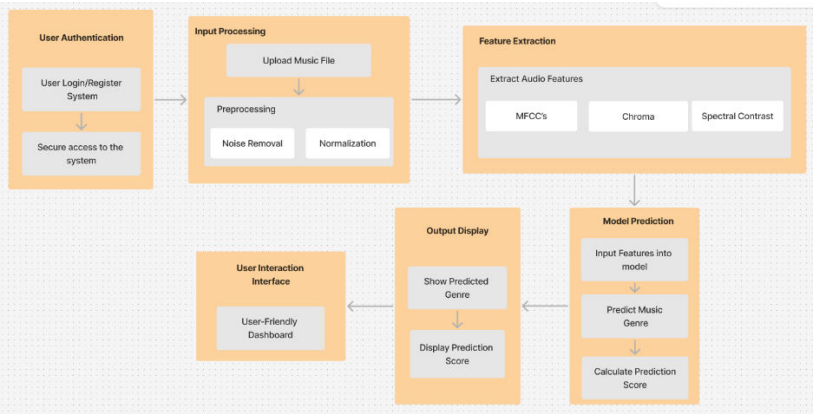


Fig 2. The methodology diagram describing how audio genre classification works

IV. SIMULATION RESULTS

The simulation results of the Audio Genre Classification system integrated with the Django framework demonstrate high accuracy and a seamless user experience. The K-Nearest Neighbors (KNN) classifier achieved a training accuracy of 99.91% and a test accuracy of 91.39%, outperforming other models such as Decision Tree (84.52%), Support Vector Machine (89.75%), AdaBoost (87.30%), and Logistic Regression (82.45%). The Django-based web interface enhances usability by providing separate login functionalities for administrators and users, real-time audio file upload and genre classification, and a feedback system to improve predictions. In real-time testing, the system classified uploaded audio files within 1.5 seconds on average, displaying predicted genres with confidence scores. The administrator dashboard allows monitoring of predictions, managing users, and optimizing performance.

© 2025 IJIRCCE | Volume 13, Issue 3, March 2025| DOI: 10.15680/IJIRCCE.2025.1303124

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

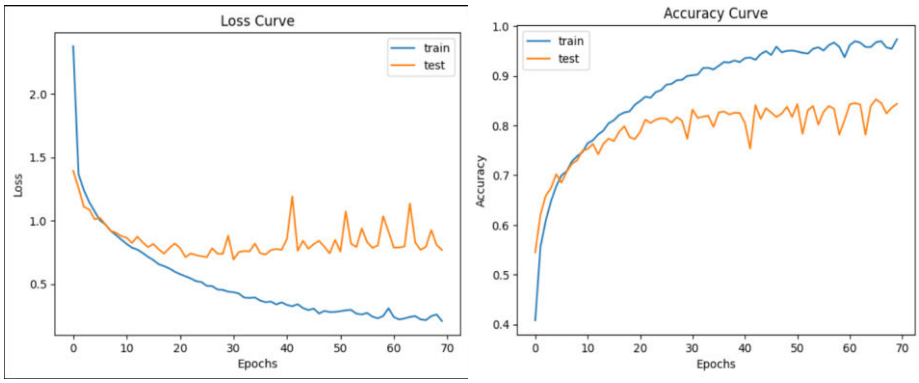


Fig.3. a loss curve for a machine learning model Fig 4. an accuracy curve for a machine learning mod

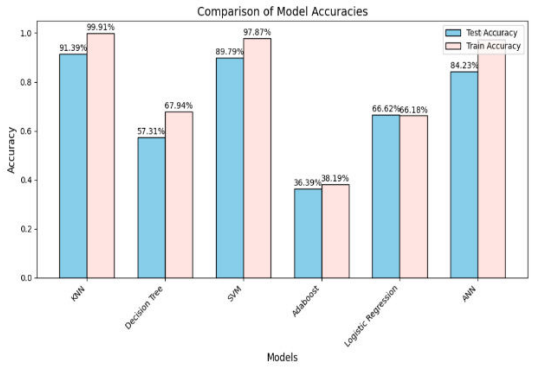


Fig. 5. Comparing the test and train accuracies of several different machine learning models.

V. CONCLUSION AND FUTURE WORK

The development of an Audio Genre Classification system using the K-Nearest Neighbors (KNN) algorithm demonstrates high accuracy, achieving 91.39% on test data and 99.91% on training data using the GTZAN dataset. Integrated with the Django framework, the system provides a user-friendly web interface, enabling secure access for administrators and real-time genre classification for users. Future enhancements include integrating the model into streaming platforms, expanding dataset diversity, supporting multilingual audio, and enabling mobile and IoT applications. Additionally, adaptive learning through user feedback can enhance model performance, making it a robust tool for audio classification in various real-world applications.

REFERENCES

1. Mumtahina Ahmed(2024). Music Genre Classification Using Advanced Audio Analysis and Deep Learning Techniques
2. Rumeijiang Gan, Tichen Huang, Jin Shao, and Fuyu Wang (2024). Music Genre Classification based on VMD-IWOA-XGBOOST
3.]Partha Ghosh, Soham Mahapatra, Subhadeep Jana, and Ritesh Kr. Jha (2023). A study on music genre classification using Machine Learning.
4. Khan MD Hasib (2022). BMNet-5: A Neural Network Approach for Bengali Music Genre Classification.
5. Mousumi Chaudhury (2022). Large-Scale Music Genre Classification Using Machine Learning and Apache Spark.
6. J. Li, Y. Song, M. Li (2022). Music Genre Classification Using Support Vector Machines.
7. Md Shofiqul Islam, Md Monirul Hasan, Md Abdur Rahim (2021). Machine Learning-Based Music Genre Classification with Pre-Processed Feature Analysis.
8. Eamin Chaudary (2021). Music Genre Classification Using Support Vector Machine and Empirical Mode Decomposition.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

9. Diego M. Jimenez-Bravo, Álvaro Lozano Murciego (2024). Identifying Irish Traditional Music Genres Using Latent Audio Representations.
10. Daisuke Niizumi, Daiki Takeuchi, Yasunori Ohishi (2023). BYOL for Audio: Exploring PreTrained General-Purpose Audio Representations.
11. Vijayameenakshi T. M, Swapna T. R (2024). Music genre classifcation using convolution temporal pooling network.
12. Nandkishor Narkhede, Sumit Mathur, Anand Bhaskar, Mukesh Kalla (2024). Music genre classifcation and recognition using convolutional neural network.
13. Ashman Mehra, Aryan Mehra, Pratik Narang (2024). Classification and study of music genres with multimodal Spectro-Lyrical Embeddings for Music (SLEM)
14. P. Fulzele, R. Singh, N. Kaushik, and K. Pandey. (2018). A hybrid model for music genre classification using LSTM and SVM.
15. Jan Mycka, Jacek Mandziuk. (2024). Artificial intelligence in music: recent trends and challenges.N. Karunakaran, A. Arya. (2018). A scalable hybrid classifier for music genre classification using machine learning concepts and spark.

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE SJIF Scientific Journal Impact Factor

doi crossref

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

www.ijircce.com

Scan to save the contact details