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AUTOMATED CLASSIFICATION OF GENRE USING MACHINE LEARNING OF INDIAN SONGS

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Abstract - Many people like to study automated music genre labeling because it is an important part of music information search systems. There is a lot of study on how to group Western music styles. Indian music has a long past that goes back to the Puranas and Vedas. In Indian homes today, music is still an important part of life. The types of music played in India depend on where you live, your society, your religion, and your language. It is hard to make software that can automatically classify different types of music like humans can. There aren't many data sets that can be used to classify Indian music. We made a library to organize and study different types of Indian music, such as Bollywood Rap, Ghazal, Garhwali, Bhajan, Bollywood Romantic, Sufi, and Bhojpuri. We made a database to sort Indian songs into genres like Bollywood Rap, Ghazal, Garhwali, Bhajan, Bollywood Romantic, Sufi, and Bhojpuri. Then, we used SVM, Gradient Boosting, KNN, Light GBM, and Neural Networks to compare how well they worked. With a score of 77.2%, the Light GBM classification is the most accurate.

Keywords:- *Music genre classification, Indian music, Bollywood, Machine learning algorithms, Light GBM classifier, Ghazal, Garhwali, Bhajan, Sufi, Bhojpuri.*

I. INTRODUCTION

Recent internet and technological advances allow customers to directly consume music via streaming applications, TVs, radios, etc. Users may now access millions of songs. This constantly developing digital music library needs precise indexing and description for user engagement. Music information retrieval systems evaluate several signals. Genre information is crucial to Music Information Retrieval. Nothing is known about Indian music, yet Western music styles have been extensively studied. Indian music's rich musical traditions and languages make

genre classification difficult. Top-level, mid-level and low-level music features exist. Human-defined mood, artist, and genre are Top Level features. Beat, pitch, pace, and rhythm are mid-level components. Timbral characteristics from a tiny frame are low-level or short-term.

Spectral centroid, roll-off, flux, MFCC, octave-based contrast, zero-crossing, and low energy are short-term features. Combining extracted features from many short frames creates temporal characteristics, such as the mean of all computed features, to demonstrate feature change across frames. Bollywood-Rap, Bollywood-Romantic, Ghazal, Folk (Garhwali), Sufi, Bhojpuri, and Bhajan are covered in this book. Most Indian music is in these categories. Garhwali is hilly music, whereas Bhojpuri is West Indian popular music. Bollywood dominates north Indian music, and most Indian films use it. Light classical or semi-classical music is Ghazal and Sufi.

Audio signal characteristics are tested to separate seven Indian music classes using SVM, KNN, Gradient Boosting, Light GBM, and basic Neural Networks.

II. LITERATURE SURVEY

Tzanetakis and Cook's (2002) pioneering work [11] inspired this endeavor. One of their pattern recognition difficulties was music genre categorization. They provided the GTZAN data set for music genre classification research. The authors employed classifiers to categorize genres using statistical characteristics from 30-second music snippets' pitch, rhythm, and timbral content.

Tao Li and Tzanetakis asserted in 2003 that MFCC and timbral features boost accuracy. Music was identified by Xi Shao, Maddage, M.C., Changsheng Xu, and Kankanhalli, M.S. (2005) utilizing Linear Prediction Cepstrum coefficients, MFCC, zero-crossing rates, Spectrum Flux/Power Amplitude Envelope, and Cepstrum Flux with Support

S. Jothilakshmi and N. Kathiresan (2012)[5] grouped Hindustani, Carnatic, Ghazal, Folk, and Indian Western music. The authors suggested employing temporal (zero-cross rate, linear prediction coefficients), energy (RMS Energy, harmonic component of power spectrum), spectral shape (centroid,

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skewness, kurtosis), and perceptual parameters to calculate classification performance. MFCC, Spectral centroid, Skewness, Kurtosis, Flatness, Entropy, irregularity, Rolloff, and Spread gave the maximum classification accuracy of 61.25% for KNN and 80.63% for GMM.

According to Sharma and Bali (2015)[10]. They suggested identifying Hindustani ragas. The four subgenres of ragas were DES, Bhupali, Yaman, and Todi. We tested four machine learning classifiers on normalized ragas. Our study extends the prior methods for identifying Indian music genres. None of these works is considered mainstream Indian music. Our goal is to automate "Hindi" genre categorization using ML models.

III. METHODOLOGY

Modules:

- Importing required Packages
- Exploring the dataset
- Data Processing - Using Pandas Data Frame
- Visualization using seaborn & matplotlib
- Label Encoding using Label Encoder
- Feature Selection
- Train & Test Split
- Training and Building the model
- A trained model is used for the prediction
- The final outcome is displayed through the front end

A) System Architecture

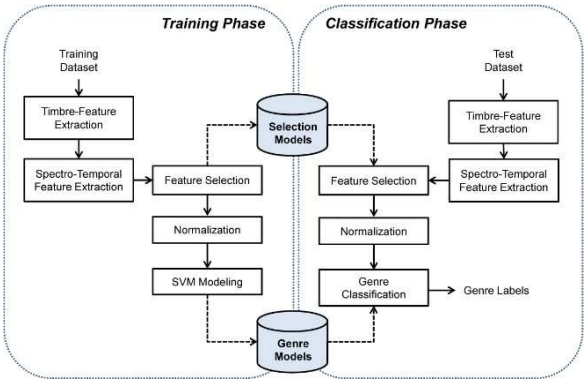

Fig 1: System Architecture

Proposed work

The proposed machine learning-based Indian music genre categorization system improves on past attempts and adds new features. The method improves AI genre categorization for Indian music in accuracy, robustness, and usability. The suggested technique will enhance feature extraction to capture more subtle Indian music elements. Besides MFCCs and chroma characteristics, the system will study rhythmic patterns, melodic

themes, and tonal structures unique to Indian music genres and styles. This will assist the algorithm grasp Indian music's tremendous diversity and improve the classification. The proposed system would use advanced machine-learning approaches tailored to Indian music. Machine learning methods like SVM and KNN, as well as ensemble models like Gradient Boosting, Light GBM, and basic Neural Networks, may capture complex music data patterns. Ensemble learning will also be researched to combine many models and improve performance. The suggested method uses sophisticated machine learning methods to improve automatic genre categorization for Indian music. The method improves genre categorization to promote India's unique musical heritage study and enjoyment.

B) Dataset Collection

The dataset comprises Bollywood Rap, Ghazal, Garhwali, Bhajan, Bollywood Romantic, Sufi, and Bhojpuri. The song selection is based on their availability in at least three manually certified Spotify playlists for the category. All YouTube tracks are obtained after human verification. Each song's onset strength, chroma stft, cqt, cens, Mel spectrogram, Mel-Frequency Cepstral Coefficients (MFCC), spectral centroid, bandwidth, contrast, roll-off, tonnetz, and zero crossing rate were generated using the Python library Librosa [7]. Vector features like MFCC and chroma stft employ the vector mean instead of the complete vector.

Pre-SVM PCA and StandardScaler processing reduced feature correlation and standardized them to unit variance. Standard Scaler transformation without PCA improves KNN classifier performance.

C) Pre-processing

To optimize machine learning methods, Indian music genre categorization data must be preprocessed in various phases. First, convert raw audio files to an analysis-friendly format. This includes utilizing Python libraries like Librosa to extract MFCCs, chroma, and spectral contrast properties. File names or databases should include music titles, artists, and genre information.

After extracting features and information, the data must be preprocessed for missing values, outliers, and inconsistencies. Imputation for missing data, outlier identification, and feature normalization or scaling may be used

to guarantee that all features contribute evenly to the model.

To avoid bias towards dominating genres, the class distribution must be balanced as the dataset contains many genres. You can use oversampling, undersampling, or SMOTE to create synthetic samples.

Finally, preprocessed data may be separated into training and testing sets for model validation. K-fold cross-validation helps provide model performance assessment robustness. Maintaining dataset integrity during preprocessing ensures that models generalize effectively to new data.

D) **Training & Testing**

A library of Bollywood Rap, Ghazal, Garhwali, Bhajan, Bollywood Romantic, Sufi, and Bhojpuri genres was carefully compiled to automate Indian music genre categorization. Machine learning algorithms are trained and tested on this database to genre-classify Indian music. Indian music is rich and diverse, affected by location, culture, religion, and language, making genre definition difficult.

Several common machine learning algorithms were used for experimentation, including SVM, Gradient Boosting, KNN, Light GBM, and Neural Networks. The dataset was split into training and testing subgroups for model robustness and generalization. Each algorithm was rigorously trained on the training subset to understand each music genre's unique patterns and attributes.

After training, the models were tested on the testing subset to determine their genre classification of Indian music. The Light GBM classifier has the greatest accuracy, 77.2%. This shows that Light GBM can distinguish Indian music genres, making it a promising candidate for music information retrieval systems.

E) Algorithms.

SVM (Support Vector Machine):

SVM is a supervised machine-learning technique for classification and regression. It finds the ideal hyperplane to divide feature space classes. SVM is resilient to overfitting since it maximizes the margin between classes, the distance between the hyperplane, and the nearest data points from each class. Kernel functions translate input data into a higher-dimensional space where classes are

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easier to separate, making SVM efficient with high-dimensional data.

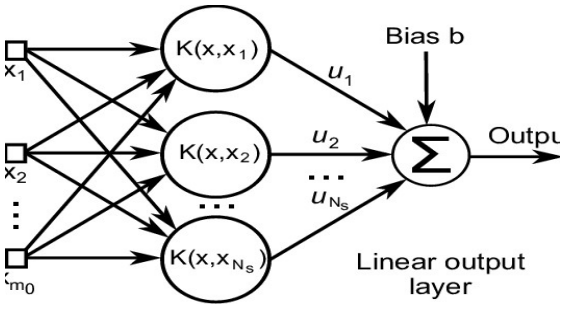

Fig2. SVM (Support Vector Machine) Algorithm

KNN (K-nearest neighbor):

KNN—k-nearest neighbors. A basic yet powerful supervised machine learning technique for classification and regression. A new data point is classified by KNN based on the majority class of its k closest neighbors in feature space. Instead of training a model, it keeps all training data and calculates data point distances to forecast.

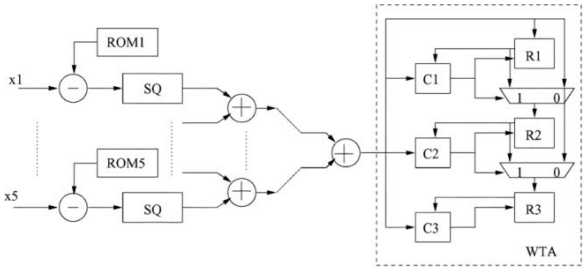

Fig2. K-nearest neighbor Algorithm

Neural Network:

Neural networks are brain-inspired computational models in data science. Neurons form layers. After processing input signals, each neuron sends an output signal to the next layer of neurons. Training neural networks with data allows them to do classification, regression, pattern recognition, and more.

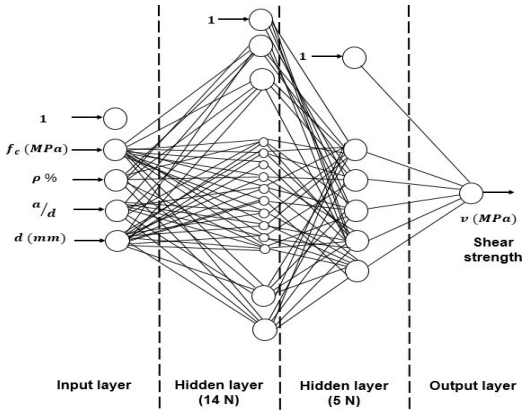

Fig3. Neural Network

Gradient Boosting:

Machine learning uses gradient boosting for regression and classification. It successively develops a predictive model from weak learners, usually decision trees. Every model fixes its predecessors' mistakes. In gradient boosting, "gradient" means using gradient descent optimization to minimize a loss function while adding new models. Boosting is the ensemble method of strengthening weak models by merging them.

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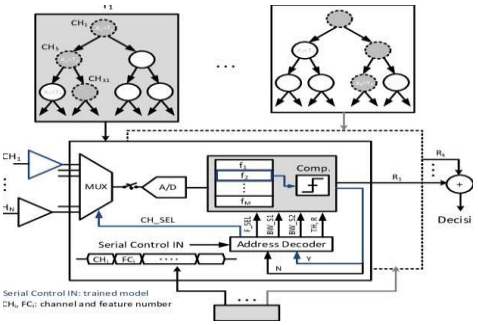

Fig4. Gradient Boosting

Light GBM:

Recent discovery of light GBM. Microsoft team introduced Gradient Boosting Machine Light (GBM) model. This gradient boosting framework leverages tree-based decision methods. Its small weight, ease of use, various parameters, and parallel learning capability make it better than other gradient algorithms. It's more accurate than gradient boosting.

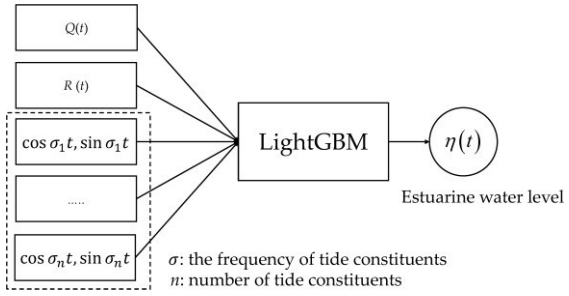

Fig5 Light GBM

IV. EXPERIMENTAL RESULTS

A) Comparison Graphs → Accuracy, Precision, Recall, f1 score

Accuracy: How well a test can tell the difference between sick and healthy people is called its accuracy. To get an idea of how accurate a test is, we should figure out what percentage of cases are true positives and true negatives. In terms of math, this can be written as

$$\text{Accuracy} = TP + TN\ TP + TN + FP + FN.$$

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

Precision: Precision is the percentage of correctly classified events or samples that are among the hits. So, the following method can be used to figure out the accuracy:

$$\text{Precision} = \text{True positives}/\ (\text{True positives} + \text{False positives}) = TP/\ (TP + FP)$$

$$\text{Precision} = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

Recall: Recall is a machine learning variable that measures how well a model can recognize all relevant examples of a certain class. It's the percentage of expected positive feelings that turn out to be real positive

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feelings. This tells us how well a model can catch instances of a certain class

$$Recall = \frac{TP}{TP + FN}$$

F1-Score: There is a machine learning rating tool called the F1 score that measures how accurate a model is. It adds up the accuracy and review scores of a model. The accuracy measurement figures out how often, across the whole collection, a model correctly predicted what would happen.

$$\text{F1 Score} = \frac{2}{\left(\frac{1}{\text{Precision}} + \frac{1}{\text{Recall}}\right)}$$

$$\text{F1 Score} = \frac{2 \times \text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}$$

B) Outputs

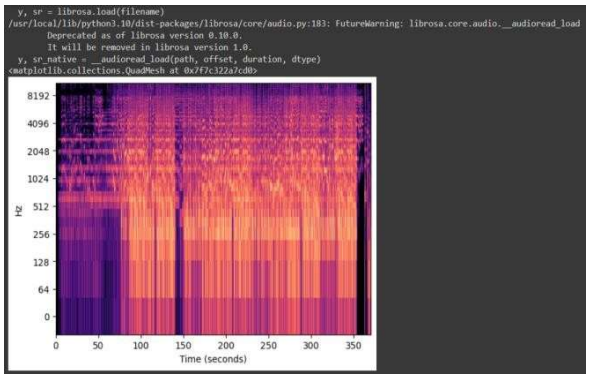

Fig6 Output Screenshots

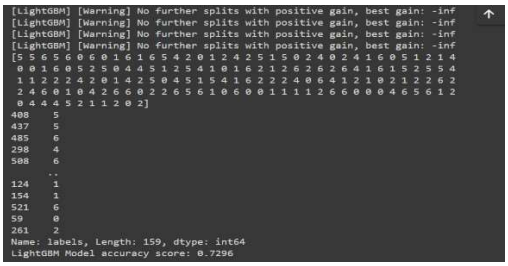

Fig7 Light GBM Output

Fig8 KNN Output:

Fig9. SVM Output

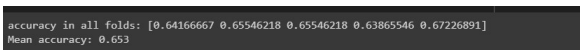

Fig10. Neural Network Output

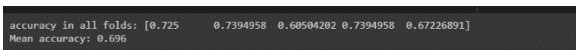

Fig11. Gradient Boosting Output:

V. CONCLUSION

Finally, machine learning (ML) genre categorization of Indian songs is a game-changing technique that will change music analysis, recommendation, and enjoyment. Using sophisticated ML algorithms and specific feature extraction methods, this system revolutionizes Indian music genre classification into Bollywood Rap, Ghazal,

Garhwali, Bhajan, Bollywood Romantic, Sufi, and Bhojpuri. This technology's ability to record complex Indian rhythmic patterns, melodic content, and tonal frameworks is one of its strengths. This allows more exact and complicated genre identification than before. This technology is suitable for music recommendation systems, radio stations, and streaming platforms because to its scalability, durability, and efficiency. This genre categorization automation method might increase user experience, cultural variety, and Indian music study and enjoyment innovation. Automated genre categorization using machine learning for Indian songs is a major advancement in music technology that might change how we listen to, analyze, and enjoy music, especially Indian music.

We found that Light GBM performs best with a certain feature set. After our testing, we observed that our classifier models conflate bhajan and garhwali genres, yet a little EDA (Exploratory Data Analysis) shows that these two genres are separate but share form instruments.

VI. FUTURE SCOPE

Automatic genre categorization using machine learning (ML) for Indian music has several potential avenues for study and development. ML algorithm refinement and optimization will improve genre classification accuracy and efficiency in future studies. Trying multiple feature extraction methods, model topologies, and training methods may help the system better reflect Indian music genres. Increasing the dataset used to train ML models is another potential opportunity. More diverse and complete Indian songs, including lesser-known genres and regional styles, may help the algorithm categorize more music. User feedback and preferences during training may increase the system's efficacy and relevance. Additionally, the automated genre categorization system might be linked to other music applications and services. For instance, music streaming services may utilize the technology to classify songs more accurately, boosting user experience and music recommendation engines. The technology might also be used with music analysis technologies to help scholars and performers understand Indian music genres. Machine learning-based genre categorization for Indian songs has great potential for music technology innovation. Researchers and developers may study, discover, and

appreciate Indian music genres by improving the system.

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