RAGAM CLASSIFICATION

A PROJECT REPORT

Submitted by

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Towards Internship completion for

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BONAFIDE CERTIFICATE

This is to certify that this project report titled **“RAGAM CLASSIFICATION”** is the bonafide work of “KALAKONDA NEHA, LINGHESH B, SWATHI G **(Reg Nos: 211501038, 211501043, 211501124)”** who carried out the project work under my supervision.

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This project report is submitted for viva voice examination to be held on …………….
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EXTERNAL EXAMINER **INTERNAL EXAMINER**

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ABSTRACT

Ragam is a term used in Indian classical music to describe the melodic framework for a musical composition. Each ragam is characterized by its own distinct musical notes and scales, and is associated with a specific mood or emotion. Identifying the ragam of a given musical phrase can be a difficult task for beginners, as it requires a deep understanding of the musical theory and structure of each ragam.

This project aims to address this issue by utilizing machine learning techniques to predict the ragam of a given musical phrase. The project will train a model on a dataset of phrases with their corresponding ragams, and use the trained model to predict the ragam of new phrases. This will provide beginners with an easy-to-use tool for identifying the ragam of a given phrase, allowing them to better understand and appreciate the nuances of Indian classical music.

Support Vector Machines (SVM) is a type of machine learning algorithm used for classification and regression analysis. SVM is particularly useful when the data is not linearly separable. The algorithm works by finding the best boundary that separates the data into its different classes. This boundary, called a hyperplane, is chosen in such a way as to maximize the margin between the classes, meaning that the distance between the hyperplane and the closest data points in each class is maximized. These closest data points are known as support vectors and give the algorithm its name.

SVM is a powerful algorithm that has been applied to a wide range of problems, including image classification, natural language processing, and bioinformatics. One of the strengths of SVM is that it can handle high-dimensional data and is not affected by the curse of dimensionality. In addition, SVM can be used with a variety of kernel functions, allowing it to model complex non-linear relationships in the data.

SVM has been extended to handle problems where the number of dimensions is much

larger than the number of samples, this extension is known as Support Vector Classification (SVC). In SVC, the algorithm solves a modified optimization problem to find the hyperplane that separates the classes, this makes it more effective in handling large-scale problems.

Overall, this project will make the process of identifying ragams more accessible and user-friendly, providing a valuable resource for beginners and music enthusiasts alike.

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ABBREVIATIONS

ML	Machine Learning
SVM	Support Vector Machines
KNN	K- Nearest Neighbors
CNN	Convolutional Neural Networks
MAE	Mean Absolute Error

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Indian classical music is a rich and diverse musical tradition that has its roots in ancient Hindu texts and has evolved over thousands of years. It is characterized by its intricate melody, rhythm, and improvisation, and is considered one of the oldest forms of music in the world. The core of Indian classical music is based on the concept of ragam.

Indian classical music is performed using a wide range of instruments, including the sitar, tabla, sarod, and veena. The music is typically performed by solo musicians or small ensembles, and often features a call-and-response style of singing known as alap. Improvisation is an important aspect of Indian classical music, with musicians frequently improvising within the structure of the ragam.

Despite its rich history and cultural significance, Indian classical music remains relatively unknown to many people outside of India. However, the music has gained increasing popularity in recent years, with musicians and enthusiasts from all over the world exploring and appreciating its intricate melodies and rhythms. Whether you are a beginner or an experienced listener, Indian classical music offers a wealth of musical experiences and emotions to explore and enjoy.

1.2 ROLE OF CLASSICAL MUSIC

Indian classical music is a rich and diverse musical tradition that has its roots in ancient Hindu texts and has evolved over thousands of years. It is characterized by its intricate melody, rhythm, and improvisation, and is considered one of the oldest forms of music in the world.

For a musician, Indian classical music plays a significant role in terms of:

1. Providing a rich musical heritage to explore and study.

2. Developing technical skills and musical expression through the performance of complex ragas and talas.

3. Promoting a deep understanding of musical aesthetics and the cultural context in which the music was created.

4. Offering opportunities for musical growth and creativity through improvisation and composition within the classical tradition.

5. Building a strong sense of musical identity and connection to Indian culture and history.

1.3 CONTRIBUTION OF INDIAN CLASSICAL MUSIC

Indian classical music contributes to us in a number of ways. Firstly, it provides a unique window into India's rich cultural heritage, allowing us to understand and appreciate the country's musical traditions. Secondly, the intricate melodic and rhythmic structures of Indian classical music can be a source of inspiration for composers and musicians of all styles, helping to shape the development of new forms of music. Additionally, Indian classical music is known for its ability to evoke powerful emotions, making it a valuable tool for exploring the human experience. By listening to Indian classical music, we can gain a deeper appreciation for the musical arts, as well as a better understanding of our own emotions and thoughts. Furthermore, the improvisational aspect of Indian classical music encourages creativity and encourages musicians to push the boundaries of their art. All in all, Indian classical music is a valuable and enriching part of our cultural heritage that has the power to shape, inspire, and connect us.

CHAPTER 2

LITERATURE SURVEY

Miss. Hemali Dodia et al.(2020) [1]This paper reviews that Music is one of the fast-growing industries in today's world and faces many difficulties. Indian Classical music, too, is different from other western music patterns and difficult to learn or identify. A lot of work has been done before using traditional approaches and expertise to identify ragas with the help of standard features such as arohana, avarohana, pakad, gamak, vaadi, savandi etc. but with the help of new features such as chromagrams, we have tried a new approach. After extraction, storage and data training with the help of a Machine Learning algorithm and a classifier such as SVM, KNN and CNN. We selected two ragas from Indian classical music, named Bhimpalasi and Yaman. The complete workflow and the features extracted are discussed here. The average accuracy of the K-NN classifier is 92 per cent and for SVM we achieved 91 per cent accuracy for raga specified with the graphical visualization of each feature. We used the python core and its various modules for a variety of purposes. Key Words: Raga, ML, Indian classical music, SVM, KNN, Chromagram.

Shrikant J Wagh et al.(2021)[2]Observed that Classification of raagas in north Indian classical music is an old subject of study of raagas and it has been done in several ways by musicologists. Although it is an old topic of study, it assumes its prime importance when it comes to teaching and learning the Indian Classical Music through any methodology, such as Guru-Shishya system or modern university pedagogical system. Dashavidh classification, Jaati method, raag-ragini classification, Raagang system of classification, raag-samay-chakra method based on the time of singing/playing, and the most widely accepted the Thaat system of classification are some of the well-known and amply described methods of raag-classification in the music literature. The present research paper puts forward a new approach based of the raag-rules. This approach takes fundamental rule of raaga composition as a base and manifests a comprehensive approach to systematically organize all raagas in seven classes. These classes are easy to remember and creates no additional ideology of its own because it does not assume any extraneous concept nor does it import/invoke any self-proclaimed principle. Therefore, it emerges out as an unassuming, explicitly accommodative and an easy system of raaga-classification.

Devansh shah et al.(2021)[3] studied that Raga is central to Indian Classical Music in both Carnatic Music as well as Hindustani Music. The benefits of identifying raga from audio are related but not limited to the fields of Music Information Retrieval, content-based filtering, teaching-learning and so on. A deep learning and signal processing based approach is presented in this work in order to recognise the raga from the audio source using raw spectrograms.

Savita M. Chauhan et al.(2017)[4] studied that, there are several research work is in progress in the direction of raag detection. Ragas are specific to the time of the day and it generates a specific sentiment only when played at the right time. It is the unique sequence in music which comprises of five to nine musical notes in melodic music. It depends on the pitch of musical notes and the mood in which they are conveyed rather than the sequence of notes. Its accurate detection is helpful in generating correct and accurate raag with the different musical instrument. There are several obstacles in accurate raag detection technique. The major challenges are the complex parameters like pitch and mood in the music, skipping extra tones, conversion of different data attributes and raag tempo. In this paper a study and analysis have been presented to stumble the gaps and finding the advantages of the previous approaches. The previous research suggests supervised and unsupervised learning both for raag detection. So this paper included the methods from above two for comparison. This study shows that the supervised learning is capable in improving the detection results.

CHAPTER 3

SYSTEM SPECIFICATION

3.1 REQUIREMENT SPECIFICATION

3.1.1. HARDWARE REQUIREMENTS

System : Intel CORE i5 8"Gen

RAM : 8GB

3.1.2. SOFTWARE REQUIREMENTS

- Google COLAB
- Pycharm
- VS Code
- Chrome Browser

3.2 PROPOSED SYSTEM

Input:

Understand the project objectives and requirements from a perspective of a beginner who wants to learn about ragas. The entire dataset is mounted and read by the program as a dataframe.

Data understanding:

Start by collecting data, then get familiar with the data, to discover first insights into the data, or to detect interesting subsets to form hypotheses about hidden information.

Data Preparation:

Includes all activities required to construct the final data set (data that will be fed into the modeling tool) from the initial raw data. Tasks include table, case, as well as transformation and cleaning of data for modeling tools.

Modeling:

Select and apply a variety of modelling techniques, and calibrate tool parameters to optimal values.

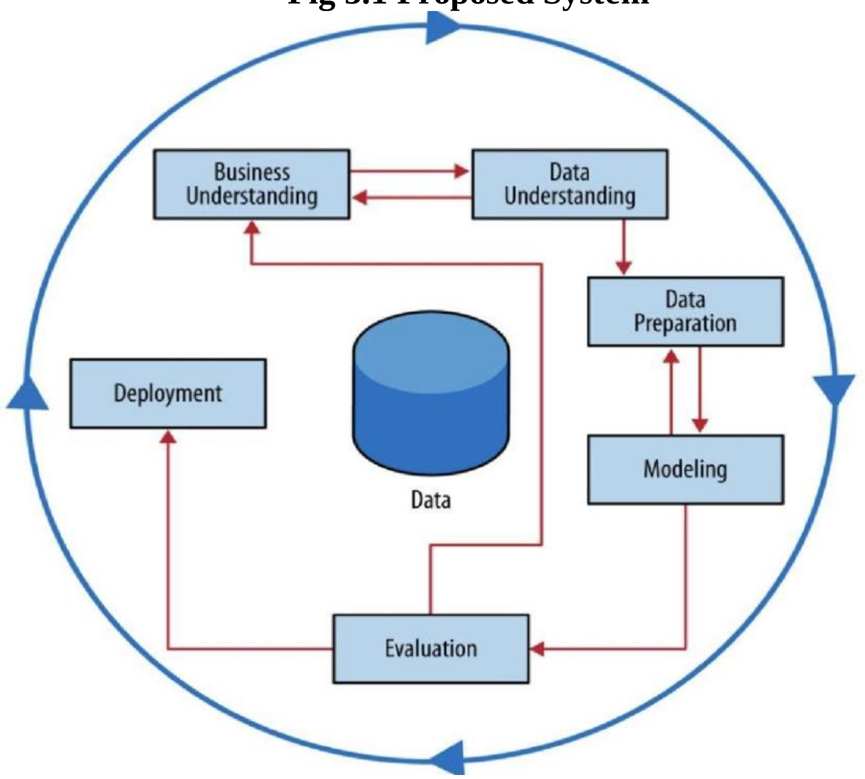
Evaluation:

Thoroughly evaluate the model, and review the steps executed to construct the model, to be certain it properly achieves the business objectives. Determine if there is some important business issue that has not been sufficiently considered.

Deployment:

Organize and present the results of the model. Deployment can be as simple as generating a report or as complex as implementing a repeatable predicting process.

Fig 3.1 Proposed System



CHAPTER 4

SYSTEM DESIGN

4.1 SYSTEM ARCHITECTURE

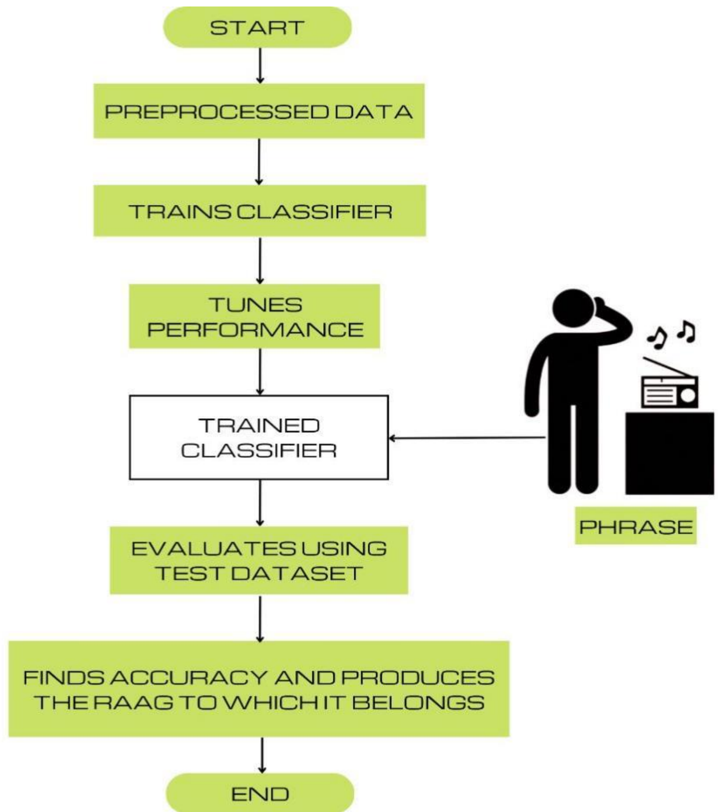


Fig 4.1 System Architecture

The figure above shows the system architecture of the raag classification project. Here initially, the dataset consists of the customer types of an automobile industry of India. The dataset has been collected from the Hyundai company. The statistical data is collected and are stored in csvfile.

Data Pre-Processing is an important step as it turns the data into a more digestible shape in order to make learning algorithms more effective. The Data Pre- Processing is done using CountVectorizer. After data pre-processing computational engine is performed.

The result from classification algorithm is evaluated and analysed using the performance metrics such as Accuracy, Recall, Precision, Confusion Matrix, F1 Score and Root Mean Square Error (RMSE). Accuracy is defined as the number of correct predictions made as a ratio of all predictions made. Recall or sensitivity is defined as the number of positive returned by the model and specificity is defined as the number of negatives returned by the model. Precision is the ratio between the true positives and to all the positives. Confusion matrix helps us to learn how our predictions have been accurate and how they stand against the real values. F1 Score is the harmonic mean of precision and recall. Root Mean Square Error (RMSE) is the square root of the mean squared difference between the target value and the value predicted by the model.

CHAPTER 5

IMPLEMENTATION RESULTS

5.1 DATASET COLLECTION

Dataset is a collection of related sets of information that is composed of separate elements but can be manipulated as a unit by a computer. Data sets describe values for each variable for unknown quantities such as height, weight, temperature, volume, etc of an object or values of random numbers. The values in this set are known as a datum. The data set consists of data of one or more members corresponding to each row.

a) The dataset used in this project is created on our own.
b) Phrases, Ragam are the attributes that are considered.
c) Total of 200 records are present in the dataset which helps us in improving the efficiency of our analysis

K14 fx

	A	B	C	D	E	F
1	**PHRASES**	**RAGAM**				
2	Sa Ri Sa Ri Ga Ga Ga Ga Ga Pa Ga Ri Ga Ga Ga Ga Ga Pa Ga Pa Ga Pa Ga Ri Ga Ri Da Pa Ga Ri Sa -	MOHANAM				
3	Sa Ri Ga Ri Ga Ga Ga Ga Ga Pa Ga Ri Ga Ga Ga Ga Ga Pa Da Sa' Da Pa Ga Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
4	Sa - Sa Ri - Ri Ga Ga Ga Pa Ga Ri Ga Ga Ga Ga Ga Pa Da Pa Ga Pa Ga Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
5	Sa - Sa Ri - Ri Ga Ga Ga Pa Ga Pa Ga Ga Ga Ga Ga Pa Da Pa Ga Pa Ga Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
6	Sa Sa Sa Ri Ri Ri Ga Ga Ga Pa Ga Ri Ga Ga Ga Ga Ga Pa Da Pa Ga Pa Ga Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
7	Sa Sa Sa Ri Ri Ri Ga Ga Ga Pa Ga Ri Ga Ga Ga Ga Ga Pa Da Pa Ga Pa Ga Ri Pa Ga Ri Ga Ri Ga Ri Sa -	MOHANAM				
8	Ga Ri Ga Da Ga Ga Ga Ga Ga Pa Ga Ri Ga Ga Ga Ga Ga Pa Ga Pa Ga Pa Ga Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
9	Ga Ri Sa Ri Ga Ga Ga Ga Ga Pa Da Pa Ga Ri Ga Pa Ga Pa Ga Pa Ga Pa Ga Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
10	Ga Ri Ga Pa Ga Ri Sa Ri Ga Pa Da Ri Ga Ga Ga Ga Ga Pa Ga Pa Ga Pa Ga Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
11	Ga Ri Sa Ri Ga Pa Ga Ri Ga Pa Ga Ri Ga Pa Da Pa Ga Pa Ga Pa Ga Pa Ga Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
12	Sa Ri Ga Sa Ri Ga Sa Ri Ga Pa Ga Ri Ga Ga Ga Ga Ga Pa Ga Pa Ga Pa Ga Ri Ga Pa Da Pa Ga Ri Sa -	MOHANAM				
13	Ga Ri Sa Ri Ga Pa Da Pa Ga Pa Ga Ri Ga Ga Ga Ga Ga Pa Ga Pa Ga Pa Ga Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
14	Ga Ri Sa Ri Ga Pa Da Sa' Da Sa' Da Pa Da Pa Ga Ri Ga Pa Ga Pa Ga Pa Ga Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
15	Ga Ga Ga Ga Ga Ga Ga Ga Ga Pa Ga Ri Ga Ga Ga Ga Ga Pa Ga Pa Ga Pa Ga Ri Ga Pa Da Pa Ga Ri Sa -	MOHANAM				
16	Ga Ri Sa Ri Ga Pa Ga Ri Ga Pa Da Sa' Da Pa Ga Pa Ga Pa Ga Ri Ga Pa Ga Ri Ga Ri Pa Ga Ga Ri Sa -	MOHANAM				
17	Sa Ri Ga Ri Ri Ga Pa Ga Ga Pa Da Pa Pa Da Sa' - Sa' Da Da Pa Da Pa Ga Ri Ga Ri Da Pa Ga Ri Sa -	MOHANAM				
18	Sa Ri Ri Ga Ri Ga Ga Pa Ga Pa Pa Da Pa Da Da Sa' Sa' Da Da Pa Da Pa Ga Ri Ga Ri Da Pa Ga Ri Sa -	MOHANAM				
19	Ga Ri Ga Ri Pa Ri Ri Ri Ga Ri Ga Pa Ri Ri Ri Ri Ga Pa Da Sa' Da Sa' Da Pa Da Pa Ga Ri Ga Ri Sa -	MOHANAM				
20	Ga Ri Sa Ri Ga Pa Ga Ri Ga Ri Ga Pa Ga Pa Ga Ri Ga Pa Da Pa Ga Ri Ga Pa Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
21	Ga Ri Sa Ri Pa Ga Ga Ri Pa Ga Ri Ga Pa Ga Ga Ri Ga Pa Da Pa Ga Pa Ga Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
22	Sa Ri Ga Pa Da Sa' - Sa' Sa' Da Pa Da Pa Ga Ri Ga Ri Da Pa Ga Ri Sa Ri Ga Pa Ga Ri Ga Ri Sa -	MOHANAM				
23	Sa Ri Ga Ga Ri Ga Pa Pa Ga Pa Da Da Pa Da Sa' - Sa Da Pa Pa Da Pa Ga Ga Pa Ga Ri Ri Ga Ri Sa -	MOHANAM				
24	Ga Pa Da Pa Ga Pa Da Pa Ga Pa Da Pa Da Da Sa' - Sa' Sa' Da Pa Da Pa Ga Pa Ga Pa Da Pa Ga Ri Sa -	MOHANAM				
25	Sa Ri Ri Ga Ga Pa Ga Ri Ga Pa Ga Pa Ga Pa Ga Ri Ga Pa Da Sa' Da Pa Ga Ri Ga Ri Pa Ga Ri Ri Sa Sa	MOHANAM				
26	Ga Pa Da Pa Ga Pa Da Pa Ga Pa Da Pa Ga Ri Sa - Sa Ri Ga Pa Da Da Sa' - Sa' Sa' Da Pa Ga Ri Sa -	MOHANAM				

Fig 5.1 Dataset of Ragam Classification

5.2 DATA PRE-PROCESSING

Data Preprocessing is a technique that is used to convert the raw data into a clean data set. In other words, whenever the data is gathered from different sources it is collected in raw format which is not feasible for the analysis. As there is no null values present in the dataset, there is no need to preprocess the data.

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 2 columns):
 #   Column   Non-Null Count  Dtype
---  ------   --------------  -----
 0   PHRASES  200 non-null    object
 1   RAGAM    200 non-null    int64
dtypes: int64(1), object(1)
memory usage: 3.2+ KB
```

Fig 5.2 Preprocessing of Data – Depicting the number of null values present in the data set

5.3 IMPLEMENTATION

5.3.1 DATA PREPROCESSING

<u>COUNTVECTORIZER:</u>

CountVectorizer is a great tool provided by the scikit-learn library in Python. It is used to transform a given text into a vector on the basis of the frequency (count) of each word that occurs in the entire text. This is helpful when we have multiple such texts, and we wish to convert each word in each text into vectors (for using in further text analysis).

5.3.2 ALGORITHMS

LOGISTIC REGRESSION:

Logistic regression is a binary classification algorithm. It assumes the input variables are numeric and have a Gaussian (bell curve) distribution. The logistic regression only supports binary classification problems, although the Weka implementation has been adapted to support multi-class classification problems.

RANDOM FOREST:

Random Forest is an extension of bagging for decision trees that can be used for classification or regression. A down side of bagged decision trees is that decision trees are constructed using a greedy algorithm that selects the best split point at each step in the tree building process

DECISION TREE:

Decision Tree is a supervised Classifier; it is an ensemble learning algorithm that generates many individual learners. It employs a bagging idea to produce a random set of data for constructing a decision tree. In standard tree each node is split using the best split among all variables.

XGBOOST:

XGBoost is an optimized distributed gradient boosting library designed to be highly efficient, flexible and portable. It implements machine learning algorithms under the Gradient Boosting framework. XGBoost provides a parallel tree boosting (also known as GBDT, GBM) that solve many data science problems in a fast and accurate way.

SUPPORT VECTOR MACHINES:

Support vector machines (SVMs) are a set of supervised learning methods used for classification, regression and outliers detection.The support vector machines in scikit-learn support both dense (numpy.ndarray and convertible to that by numpy.asarray) and sparse (any scipy.sparse) sample vectors as input.

NAIVE BAYES:

Naive Bayes methods are a set of supervised learning algorithms based on applying Bayes' theorem with the "naive" assumption of conditional independence between every pair of features given the value of the class variable.

KNN:

The k-nearest neighbors algorithm, also known as KNN or k-NN, is a non-parametric, supervised learning classifier, which uses proximity to make classifications or predictions about the grouping of an individual data point. While it can be used for either regression or classification problems, it is typically used as a classification algorithm, working off the assumption that similar points can be found near one another.

5.3.2 COMPARISON OF ALGORITHMS BASED ON PERFORMANCE

Table 1: COMPARISON OF ALGORITHMS BASED ON PERFORMANCE

Algorithm	Time taken to build model (sec)	Correctly Classified Instances (%)	Incorrectly Classified Instances (%)	Mean absolute error
XGBoost	0.03	60	40	0.4
KNN	0.15	97.5	2.5	0.025
SVM	0.03	100	0	0.0
Naive Bayes	0.09	100	0	0.0
Decision Tree	0.18	100	0	0.0
Logistic Regression	0.15	100	0	0.0
Random Forest	0.68	100	0	0.0

The above table (TABLE 1), compares the various classification algorithms based on various performance metrics such as MAE. It can infer that SVM performs well compared to other algorithms like Random forest and XGBoost as the time taken is lesser and the MAE is lower compared to that of other algorithms.

5.3.4 COMPARISON OF ALGORITHMS BASED ON METRICS

Table 2: COMPARISON OF ALGORITHMS BASED ON METRICS

Algorithm	ACCURACY	PRECISION	RECALL
KNN	97.0	97.0	98.0
XG BOOST	60.0	30.0	50.0
NAÏVE BAYES	100.0	100.0	100.0
SVM	100.0	100.0	100.0
DECISION TREE	100.0	100.0	100.0

The above table (TABLE II), compares the various classification algorithms based on various performance metrics such as accuracy and precision. It can infer that XG Boost performs well compared to other algorithms like Random forest and Naïve Bayes as the Accuracy is higher compared to that of other algorithms.

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 CONCLUSION

The purpose of this paper was to classify and analyse two major raag -MOHANAM and HAMSADHVANI - using basic machine learning classification algorithms. As such, this classification can be utilized by beginners who are intended and interested to learn about raags and its classification.

This project works very well and can classify the given set of stanzas into two main raag classes, Mohanam and Hamsdhvani.It accounts each swaram present in the given stanza and are encoded by the feature extraction technique, CountVectorizer which gives importance to each swaram, the number of occurrences, etc., that helps in understanding the stanza even better.

6.2 FUTURE WORK

This project can be improved in the future to categorise additional raags by simply adding more stanzas of different raags to the dataset and enhancing the algorithm that can deliver the highest level of accuracy. It is also possible to adapt this project to accept audio data instead of text data as input. Future developments may potentially be made to the interface utilised here

APPENDIX 1- SAMPLE CODE

```
import numpy as np

import pandas as pd

import pickle

from sklearn.model_selection import train_test_split

from sklearn.feature_extraction.text import CountVectorizer

from sklearn import svm
data=pd.read_csv("/content/PROJECT - Sheet1(expanded) - Copy.csv")
data['RAGAM']=data['RAGAM'].apply(lambda x: 0 if x=='MOHANAM' else 1)
data.head(5)
X=data['PHRASES']
Y=data['RAGAM']
vectorizer = CountVectorizer(stop_words=None)
X = vectorizer.fit_transform(X)
from sklearn import svm
classifier= svm.SVC(probability=True)
classifier.fit(X,Y)
X_train,X_test,Y_train,Y_test=train_test_split(X,Y,test_size=0.2)
ans=classifier.predict(X_test)
from sklearn.metrics import confusion_matrix, classification_report, accuracy_score,r2_score
print(classification_report(Y_test,ans))
l=np.array(["ga' ri' sa' ri' ri' ga' ri' sa'"])
l1 = vectorizer.transform(l)
classifier.predict(l1)
pickle.dump(classifier,open('model.pkl','wb'))
pickle.dump(vectorizer,open('vector.pkl','wb'))
```

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