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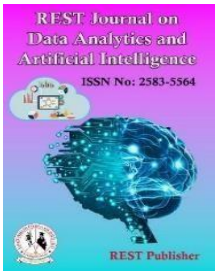

Item-based Collaborative Filtering Music Recommendation System using Machine Learning

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Abstract. *We focus on recommending songs based on the listener's mood using a machine learning approach. Existing technologies and projects in this domain include platforms like Spotify and Apple Music, which utilize collaborative filtering and deep learning for music recommendations, often based on user behaviour and preferences. We aimed to develop a model that accurately captures the emotional state of the user and suggests songs that align with their current mood, enhancing the personalization of music recommendations. By implementing the K Means algorithm, we clustered songs based on mood features derived from audio data, such as tempo, key, and energy levels. Our model successfully grouped songs into distinct mood clusters and provided mood-appropriate recommendations, demonstrating the potential for a more intuitive and emotionally resonant music recommendation system.*

Keywords: *t-SNE, Manifold Learning, E-commerce, recommender system, item-based recommendation, content-based filtering.*

1. INTRODUCTION

On the web, where the measure of decisions is overpowering, there's a prerequisite to filter, organize and proficiently convey significant data to lighten the matter of data overload, which has made a potential issue for a few Internet users. Recommendation settles the issue of giving the best outcomes by giving the results of top information which is dynamically generated using the required methods and data. Moreover, of late, interpersonal organizations turned out to be generally utilized and well-known modes for information dissemination likewise on account of the facilitators of social interaction. User commitment and exercises give important understanding into singular conduct, encounters, assessments, and interests. Considering the metadata together with the client information gives more approaches to build the exhibition of strategies like shared separating. Recommendation systems have been introduced into a variety of areas with challenges. These include Government recommendation systems, Government service recommendation, E-business recommendation systems, A Telecom recommendation system, Commerce/shopping recommendation systems, Library recommendation systems, Learning recommendation systems, Tourism recommendation systems, Service recommendation systems [1-4]. Various models used models for music recommendation can including music recommendation models such as content-based, emotional, which is used for people; collaborative, which uses information in addition to the content; and additional content and metadata-based, which includes information about music and genres [2]. The collaborative recommendation has served well but has weaknesses such as being prone to popularity bias, the limitations of human actions, etc. Concerning the other disadvantages, the hybrid system has not yet been studied extensively, but on the other hand, it does offer greater performance concerning the breadth of opinion. Both the emotional and social information are considered models of the recommendation that have a great impact on the overall quality of the recommendations This topic is just beginning to be researched and will continue

to expand in the coming years.Recommender systems enhance user experience and profitability for platforms like Netflix, Amazon, and Spotify by offering personalized suggestions based on search history and preferences. For example, Amazon recommends similar products and frequently bought items, while Netflix suggests content based on viewing habits, genres, and themes. Music platforms like Spotify also tailor recommendations to user tastes. [3]

2. LITEATURE SURVEY

The Internet is a source of infinite information with rapid growth. There are millions of e-commerce websites on the internet and so are the products available, which leads customers not to make the right decisions. The different components of recommendation systems are items, users and user-item matching algorithms, various approaches of recommendation systems.The introduction of recommendation systems has proved itself to be priceless and is appreciated because of their ability to make customers make the right choices in time. Recommender Systems are software tools that use techniques for providing product suggestions to a user. The hints identify with different decision-making processes, for example, what things to purchase, what music to tune in to, or what online news to peruse. The recommendation system carries out its process by analyzing the user's visit to its website and remembering their choice. This analysis is further used to suggest the user [5-7]. Recommendations are classified into two types based on the number of users the system suggests to. When the interest of a single user is noted to provide him the suggestion, it is known as a personal recommender system. Since a personal taste cannot be the same for different users, this type of recommenders is used based on the user's taste or preference [8]. Another type of recommender system is called public recommendations or impersonal recommendations. When a system grabs the interests of users on a large scale, basically to make recommendations based on the popularity of the item [9-10]. By the definition of the recommendation system, it is clear that there would be something that captures the user's behavior, and analyzing that behavior would result in future predictions. The thing that provides this capability to a system is said to be "user modeling" or "user profile". User profile or user modeling is the basic unit of every kind of recommendation system. The framework stores data about the user's behavior into the user's profile. The data is about the user's most continuous visits, top quests, and so forth. A famous e-commerce website, Amazon also uses a recommender system to provide suggestions to its customers. It uses the active search recommender which suggests the buyer items which are similar to his previous searches and similarity-wise [11-12]. This form of recommender uses the technique called user to use collaborative filtering as the algorithm does the searching of items with users having similar patterns of purchasing. There are millions of choices of music available online. A proper method of filtering and prioritizing among them is needed for different users. To decipher such problems, recommender systems play a vital role by providing the results of top data which is dynamically generated using the required methods and data [13].

3. PROPOSING SYSTEM

To achieve the goal of the paper, the first process is to do enough background study, so the study will be conducted. The whole paper is based on a big amount of music data so that we choose the quantitative research method which is shown in Figure 1. For philosophical assumption, positivism is selected because the paper is experimental and testing character. An approach is a deductive approach as the improvement of our research will be tested by deducing and testing a theory. Ex post facto research is our research strategy, the music data is already collected and we don't change the independent variables [14-16]. We use experiments to collect music data. Computational mathematics is used in data analysis because the result is based on the improvement of algorithms. For quality assurance, we have a detailed explanation of algorithm to ensure test validity. Similar results will be generated when we run the same data multiple times, which is for reliability [17-18].

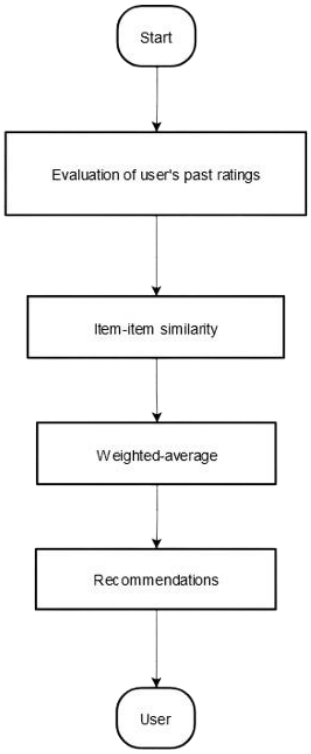

FIGURE 1. Flow Chart

4. APPROACH

So far, the audience or crowd are reliable with their knowledge contributes to the majority of new business expansion strategies' advice and feedback, which are strong. overall. Leveraging content is the core concept of a recommender framework to rank and sort long-tail users' particular preferences, in a straightforward way is rather than serving the objects with simple precision [19]. One limitation of the effective recommendation filtering for active filters is "popularity". This problem originated. with the Long Tail phenomenon, which states that a large number of users use very few but popular items while a small number of users consume less popular items. Since collaborative filtering is based on the preferences of people to produce recommendations, it leads to poor variations of recommendations (since most people prefer to use only popular items). E.g. Celma has shown that the music industry follows a long tail [20]. This algorithm isn't personalized; it simply recommends the most popular items to a user. As the popularity is based upon the people count hence it provides better results. The final motive of a system is to provide the best recommendation based on the available features that are both user data and song data. Item-Based collaborative filtering:Item-based filtering is different, assuming users will like the same things that user preferences do. So, the first step in item-based filtering is to find things like what the user liked before. The main point of item-based filtering is to calculate the similarity of two items. The CF items consider that users' preferences are the same. Item CF considers that items that are liked by more same users, the more similar they are. Assume N(i) and N(j) are user sets who like i and j respectively. Hence the similarity of i and j can be defined as in equations 1 and 2 and table 1.

$S(i,j) = |N(i) \cap N(j)| \, |N(i) \cup N(j)|$ E.q(1).
$P(u,i) = \text{Sigma}(j \text{ (foreach) } S(i,k) \cap N(u) \, S(i,j) \, R(u,j))$ E.q(2).
While User C prefers Item 1, so we can find that maybe User C loves Item C too.

TABLE 1: Item-based CF

User/Item	Item-1	Item-2	Item-3
User-A	Yes		Yes
User-B	Yes	Yes	Yes
User-B	Yes		Recommend

5. RESULTS

TABLE 2. Comparison between popularity algorithm and collaborative algorithm

Model	Precision	Recall
Popularity algorithm	0.87	0.83
Item-Based Collaborative filtering algorithm	0.90	0.86

6. CONCLUSION

Understand how the recommendation works in the case of songs and provides the users with the best results. The final result made us understand how to use the data to get a good recommendation output. Furthermore, the results made us understand that good precision and recall from our work improved the overall result. Finally, few methods have been developed that work for providing the users with the best results using details like listen, count, user id, song – artist. Recommendation programs have proven to be the best solution to solve the problem of information overload. Decisions can be made more quickly and easily by the use of time and resources saved Research on music, human behavior, and how it is linked to the impact of music has risen over the last few years, and in p articular, to the expansion of the temp oral lobe has been active over the last decade Since music is so vital to our daily lives, now that we have greater advancements in technology, we can connect with people anywhere people, more easily. It is very difficult to satisfy the requirements of one's interests and maintain the service in the long term while serving clients are so diverse. Therefore, prospective recommendation systems can enable decisions that are made more intuitive to the consumer, so that they can make the best decisions possible. And of course, it will provide automatic music suggestions to bootleg copies of the song results, which will please the consumer as well. In this paper, we have described the elements of the music recommendation system and the various models that can be used for recommendation such as popularity, collaborative item filtering, user-based filtering. The cooperative complementary model has achieved great success but has issues such as willpower, human effort, etc. Future work will focus on expanding the existing methods and algorithms used so that the forecast recommendation system and the quality of the recommendations can be improved.

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