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Content Based Movie Recommendation System

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A B S T R A C T

Recommendation based systems can be used for recommending different web page, books, restaurants, tv shows, movies etc. The aim of movie recommendation system is to recommend movies to different users based on their interests. This helps the user to save time browsing the internet looking for movies from the thousand already existing ones. Content-based recommendation system describes the items that may be recommended to the user. Based on a data set, it predicts what movies a user will like considering the attributes present in the previously liked movies. Recommendation systems can recommend movies based on one or a combination of two or more attributes. While designing a movie recommendation system various factors are considered such as the genre of the movie, the director or the actors present in it. In this paper, the recommendation system has been built on cast, keywords, crew, and genres. A single column is created which will be the sum of all the 4 attributes, and it acts as a dominant factor for this movie recommender system.

Keywords: Content based recommendation, PyCharm, Python, Machine learning, Web application.

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1. Introduction

The enhancement of science and technology leads to make the life more comfortable than older days. The emerging technologies like neutrosophic shortest path [1-5], transportation problem [6-8], uncertainty problem [9-14], fuzzy shortest path [15-18], powershell [19], wireless sensor network [20-27], computer language [28, 29], neural network [30], routing [31], image processing [32] making the products more intelligent and self-healing based. The smart city applications like smart water [33, 34], smart grid, smart parking, smart resource management, etc. are based on IoT and IoE [35-38] technologies. In this manuscript, the recommendation system has been built on cast, keywords, crew, & genres. The recommendation system aims to predict or take users' interests and recommend related items that quite likely are interesting for them. The growth in the amount of information that is available online and the increase in the number of Internet users has created an overload of information which makes it difficult to find the correct information at the right time. The recommender system solves this problem by

filtering the required data from a large amount of information that is generated based on the user's interest or preferences.

Recommender systems are used for recommending products, generating playlists, matchmaking, and a lot more. Recommender systems function with characteristic information and user-item interactions. Characteristic information is the information about the user and the items whereas user-item interaction is the information regarding ratings, the number of purchases, likes of the users, and many more. Based on this, the recommendation system can be developed using collaborative filtering, content-based filtering, or hybrid filtering [39-41].

Collaborative Filtering. This system identifies users with similar tastes and uses their opinion to recommend the same to another user with similar interest. It generates recommendations using information about rating profiles for different users or items. It has been implemented in different applications such as YouTube, Netflix, and Spotify. It is a widely used approach and is used as a part of the hybrid system.

Content-Based Filtering. Content-based filtering methods are done based on user characteristics. This method is used in situations where data is known on an item such as name, location, or description and not on the user. It predicts the items based on user's information and completely ignores contributions from other users as with the case of collaborative techniques. It uses the data that is provided by the user either explicitly or implicitly. When the user provides more content-based filtering mechanisms actions on the recommendations such as content-based recommender the engine becomes more and more accurate.

Hybrid Approach. A hybrid approach is a combination of collaborative filtering content-based filtering, or any other approaches. Hybrid approaches can be implemented by making predictions separately on content-based and collaborative-based approach and later combining them. It increases the accuracy and performance of the recommender systems.

2. Problem Definition

In collaborative filtering, the system combines the interest and preferences of many users. This results in various issues such as cold start, scalability, and sparsity [42]. Cold start problem occurs when a new user or an item enters the system and similar items cannot be detected because of the lack of information. It also requires a large amount of existing data on which the user can make correct recommendations [43]. It is also called the new user problem or new item problem [44, 45]. Chances of new users getting good recommendations on new products will be low because of the lack of rating or purchase history by the existing users.

The problem of scalability occurs because of the huge amount of information that is being generated daily. A large amount of computation power is often necessary to calculate recommendations and how quickly a recommender system can generate a recommendation.

Every active user must have rated very few products or items that are available in a huge database. This prevents the rest of the items from going unnoticed by the rest of the users. This leads to data sparsity.

Content-based filtering techniques normally generate their predictions based on the user information and does not rely on the contributions or ratings from other users as done in collaborative techniques [46, 47]. It helps in building their user profile by providing independence that is specific to that particular user. This makes it easier to scale to a large number of users. The models understand the interests of a user specifically, and recommend items that best matches which are the interest of very few other users. Our system provides a web application to the user in which the user can give their inputs and generate outcomes based on their interest. It also displays the top-rated movies and also the most popular movies among them.

3. Literature Review

After the study of recommending items from some fixed database has been done, two main recommending techniques have emerged which are content-based technique and collaborative technique.

In content-based recommendation, items are recommended which are similar to those provided by the user, whereas in collaborative recommendation users whose tastes are similar are identified to those of the given user and recommends items they have liked. Later with the evolution of the recommender system hybrid method has been invented which merges two or more techniques.

Before the invention of the recommending system, people had to read reviews and choose the movie that best suited their interest or had to randomly choose any movie based on some other criteria. This became difficult as the number of movies that are available online started increasing rapidly.

3.1. Different Researcher's Contributions

Some of the major contributions on the existing movie recommendation systems are discussed in ***Table 1***.

Table 1. A literature review on existing systems.

Authors	Years	Different approaches on movie recommendation
Fisk [48]	1996	The author proposed a method where the movie recommendation system is based on the principle of social filtering.
Chen and Aickelin [49]	2008	The authors proposed a model in which artificial immune system technology is applied to collaborative filtering technology.
Choi and Han [50]	2010	The authors proposed a different collaborative filtering approach based on the category correlation of contents.
Son and Kim [51]	2017	The authors proposed a method that uses the multi-attribute network to reflect several attributes when calculating correlations.

Table 2 discusses the different contributions in recommendation system.

Table 2. Literature review on recommendation system.

Author	Year	Different approaches on recommendation system
Basu et al. [52]	1998	The authors proposed a model in which the user likes and dislikes are taken to compute the rating threshold for movie prediction.
Debnath et al. [53]	2008	The authors proposed a hybridization of content-based and collaborative techniques for the recommendation of movies.
Deldjoo et al. [59]	2016	The authors proposed new algorithms for youtube video recommendation systems.
Jannach et al. [54]	2010	The authors proposed the basic concepts of recommendation systems and their recent developments.

Table 3 discusses the different contributions in collaborative and content based approach.

Table 3. Literature review on collaborative and content based system.

Author	Year	Different approaches on Collaborative and Content based system
Basilico and Hofmann [55]	2004	The authors proposed a model in which a unified approach integrates all the available training information such as past user-item ratings as well as attributes of items or users to learn a prediction function.
Liu et al. [56]	2010	The authors proposed a model in which personalized news recommendation system is made by developing an effective information filtering mechanism.
Hameed et al. [57]	2012	The authors proposed different measures, methods, algorithms, and functionalities of the collaborative filtering method.
Uluyagmur et al. [58]	2012	The authors proposed a method in which content-based movie prediction is done by merging the user-specific weight using a particular feature set.
Deldjoo et al. [59]	2016	The authors proposed a model that values a technique that is used to analyze the contents of a video to extract a set of stylistic features such as lighting, colour, and motion.

Table 4 discusses the different contributions on filtering techniques.

Table 4. Literature review on filtering techniques.

Author	Year	Different approaches on filtering techniques
Goldberg et al. [60]	1992	The authors introduced the collaborative filtering technique.
Good et al. [61]	1999	The authors proposed a model to alleviate information overload by using Information filtering agents and collaborative filtering.
Adomavicius and Kwon [62]	2007	The authors proposed the similarity based approach and the aggregation function-based approach.
Liu et al. [63]	2014	The authors introduced a new method to provide an accurate recommendation.

The previous recommendation systems had certain gaps in them such as:

- Since it is based on the user ratings, it does not recommend any new product or items.
- Products or items which already exist but have not been rated by any user will not be considered for recommendation to a new user.
- A large amount of computation power is used.

Therefore, this motivates us to provide new model for the society:

- The method of cosine similarity is used to determine how similar documents are, irrespective of their size.
- Every item new and old, rated, and non-rated are recommended to the user based on their input.
- It also displays the top voted and the most popular movies.

4. Description of the Research Work

One of the major problems that exist in the collaborative filtering is that it provides recommendation of items based on user ratings and user preferences. If an item is not rated by any user it can affect the accuracy of the recommendation and the product is not recommended to a new user. Only when adequate information about a user is provided or only if the user has given ratings on any items or products the system is able to identify the user and provide the recommendations. A content-based recommender system overcomes these challenges of collaborative filtering. The recommendation accuracy is not affected as the user preferences are not considered and it provides privacy to the user as they need not share any information about themselves. This system also can adjust its recommendations very fast when different users do not share the same item preference. In the method used the user provides the name of a movie based on which outputs are generated. Ten movies that are similar to the input given by the user will be displayed as output.

4.1. Pseudo Code of Proposed System

Table 5. Pseudo code movie recommendation system.

Steps	Overview
Step 1	Import the dataset and perform the data pre-processing steps.
Step 2	Import Pandas and create count matrix using the count vectorizer method.
Step 3	Using Cosine similarity matrix determines the similarity of documents irrespective of their size.
Step 4	Create a directory setup for the website where the main input field is placed inside the form.
Step 5	Connect the page to flask and render it.
Step 6	In the terminal open the python file and provide the link in the browser.
Step 7	The user enters the movie name and if it is available in the dataset the cosine matrix is calculated and top 10 similar movies are sorted and displayed to the user.
Step 8	If the movie does not exist in the dataset then message regarding the reason for the same is displayed.
Step 9	Five top voted and top five popular movies are also displayed in their respective pages.

5. Result and Discussions

The content-based recommendation is best in situations where there is known data to the item rather than the user as it analyses the attributes of items for generating predictions. ***Figure 1*** shows the homepage of our website. The user can enter a movie name in the given text box and then click the "Submit" button. The home page also provides two other options for the users, to view five movies based on the popularity and the vote count.

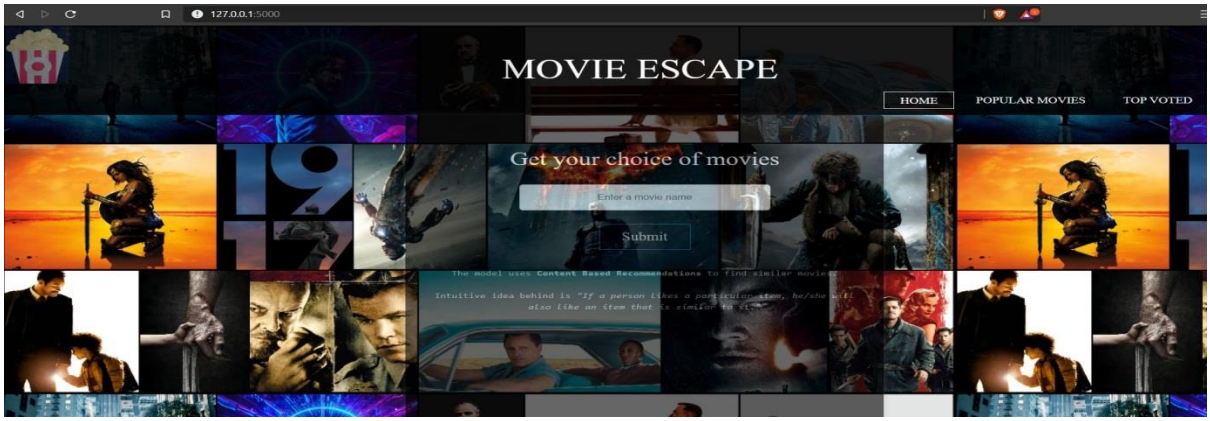

Figure 1. Our proposed movie recommendation system website home page.

In ***Figure 2*** and ***Figure 3***, the recommendations that are given to the users are shown based on the input that they have provided to our proposed system.

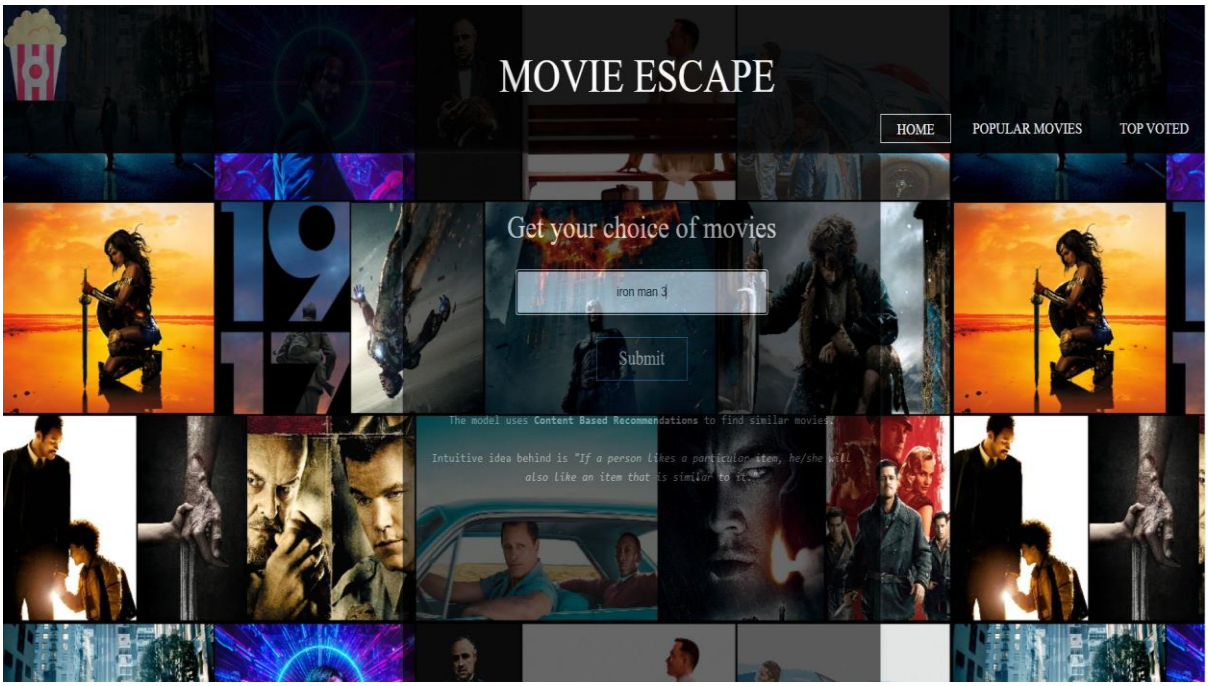

Figure 2. Home page of our proposed movie recommendation system with user input option.

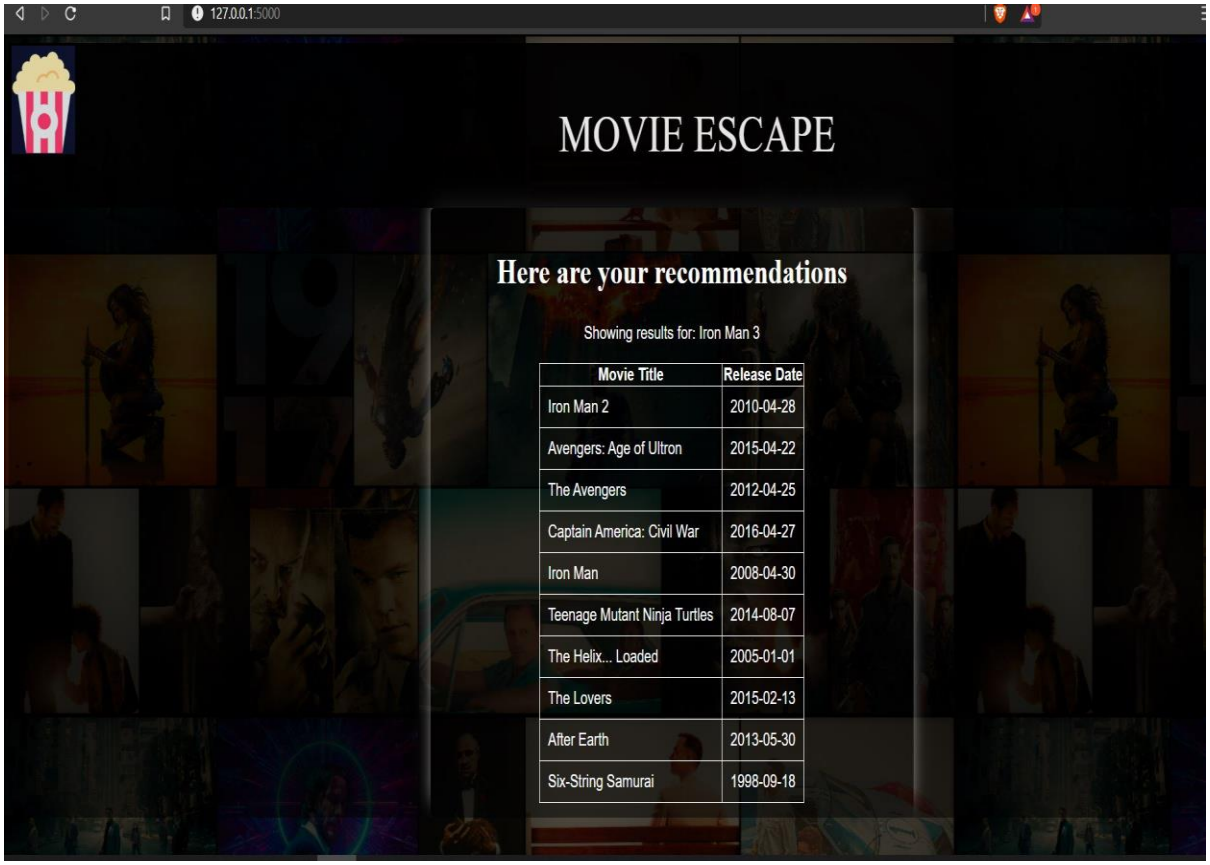

Figure 3. Search result suggestions based on the search input “Iron Man 3”.

Figure 4 and ***Figure 5*** show the popular movies of all time and top voted movies by the users.

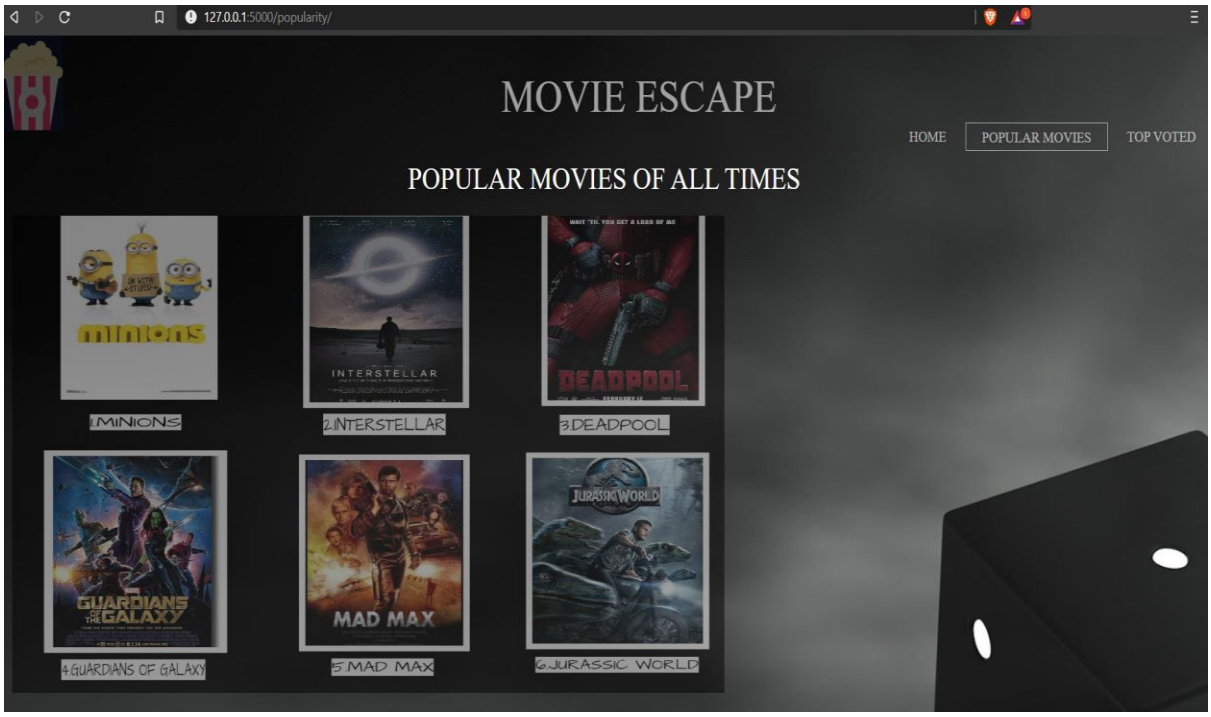

Figure 4. Popular Movies of all time.

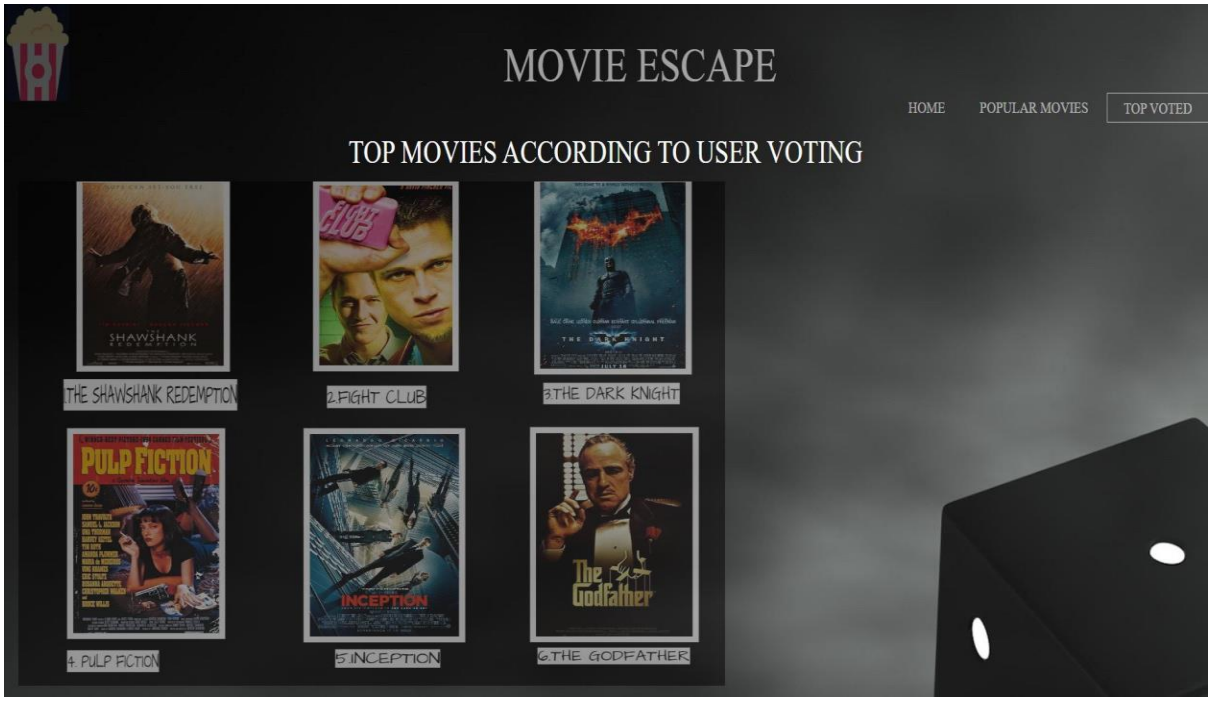

Figure 5. Top voted movies by users.

6. Conclusion

Information retrieval has become very difficult nowadays because of the overloading of data and this issue has restricted the users from accessing the items that best match their preferences. This is where the recommendation system comes into use. It helps to retrieve personalized information for different users. Also, movies have become a popular medium of entertainment but also the concern of what to watch is also rising along. The content-based recommendation approach does not consider other user profiles while making recommendations. This will help the user get personalized suggestions for their input.

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