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Knowledge Based Location Recommender Systems

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ABSTRACT
By anticipating user reviews of the respectiveproducts or contents and highlighting those that have received high marks, recommendation systems help consumers discover a variety of goods and contents. We want to recommend a location to the user who loves traveling, based on his user's current location we will recommend the location. We are using knowledge based since knowledge-based recommender systems are a particular kind of recommender system that is based on knowledge about the item selection, characteristics, and ranking criteria and we employ them. In our project we are using "geolocator.geocode" to find the longitude and latitude of cities present in our dataset. Now we have to give the input to the user and the user will give his location so we can give some recommendations of locations to the user. We apply the K-means clustering algorithm such that we can get all the nearby locations from the current location. By using K-means we can form clusters within the same data point. After using K-means we can easily recommend the locations to the user. We also want to recommend some hotels to the user for staying and we are creating a webpage so it is easy for the user to use the web application and find a particular hotel for staying and find locations to visit. We are using flask which is a web application framework written in Python. It will connect the front and back end of the web application where our back end is machine learning.

KEYWORDS: Recommendation systems, Content-based,collaborative filtering, Knowledge-Based filtering.

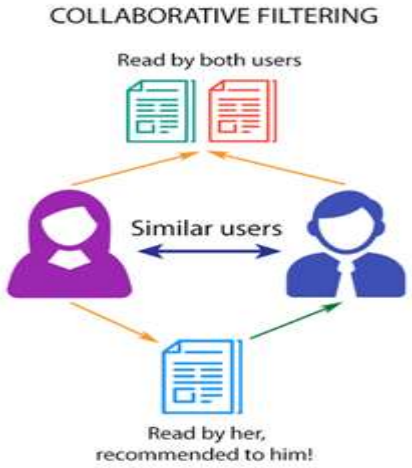
I. INTRODUCTION

Recommendation technology has become a popular subject of study and debate in the information technology sector over the past ten years. Applications and industries where recommendation systems have been employed include detection and prevention, transportation, e-commerce, the environment, energy, healthcare, and recreation, among others.

The three types of procedures that are most frequently employed are collaborative filtering, content-based filtering, and hybrid systems.

Collaborative filtering:

It is not necessary to provide the object's features in order to collaborate. Each user and item is described by a feature vector or embedding. It produces embedding automatically for both users and products. In the same embedding space, both users and items are included. It considers other users' comments when promoting a certain person. It records the goods a certain user likes as well as the goods that other users who exhibit similar behaviours and interests love promoting to that user. It compiles user feedback on various items and utilises it to provide recommendations.



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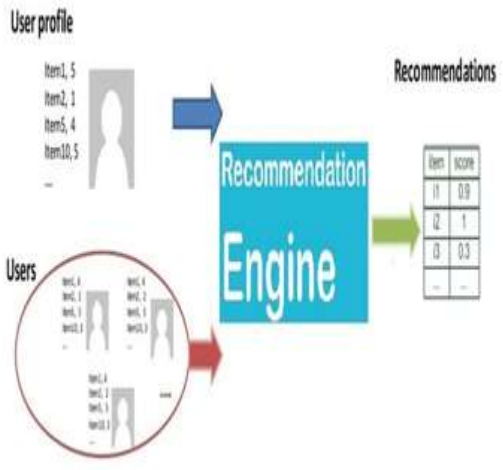
Movies	User 1	User 2	User 3	User 4	Action	Comedy
Item 1	1		4	5	Yes	No
Item 2	5	4	1	2	No	Yes
Item 3	4	4		3	Yes	Yes
Item 4	2	2	4	4	No	Yes

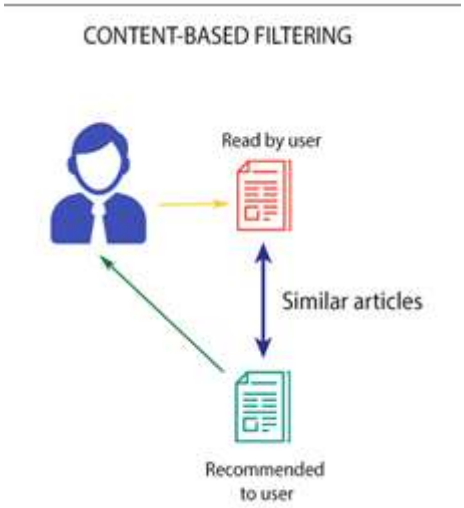
Similarity Metrics:
They are mathematical measures which are used to determine how similar is a vector to a given vector. Similarity metrics used mostly:

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

Cosine Similarity: The Cosine angle between the vectors.
Dot Product: The cosine angle and magnitude of the vectors also matters.
Euclidian Distance: The elementwisesquared distance between two vectors
Pearson Similarity: It is a coefficient given by:

Content-Based Filtering:
A content-based recommender system seeks to infer, based on the features of the item that the user responds favorably to, the features or behavior of the user.
Last two columns: Comedy and Action Give examples of the film genres. Given these genres, we can now identify which users prefer which genre, allowing us to develop features tailored to that user based on how they respond to films in that genre.





Knowledge-based Filtering:
A Knowledge-Based Recommendation System sets itself apart from other Recommendation Systems by using a different method to create a recommendation. The recommendations produced by a KBRS are based on domain knowledge. Users will receive suggestions based on their own profiles, not on the actions of other users, or, if it is, it will not be a significant element in determining the recommendation.

Components of a Knowledge Base Recommendation System:
Knowledge Base: One of the key elements of knowledge-based systems is the knowledge base. The nature of the knowledge base changes depending on the types of KBRS. The recommendation strategy's character and the knowledge base's nature are interconnected and have an impact on one another.

User profile:A user profile must be made because a KBRS offers the user a personalized recommendation. The methodology and suggestion strategy taken into account determine the profile's content. Overall, we may conclude that the user's preferences, tastes, interests, needs, etc. make up the profile.

II. LITERATURE SURVEY:

We studied some survey papers and one of the survey paper's is from the research [1].After conducting the survey, we get to know that these methods have advantages as well as disadvantages. We have drawbacks for collaborative filtering, such as the new user problem, where the

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recommendation engine must figure out the preferences of the users in order to produce trustworthy recommendations. The problem of grey sheep and sparsity which are further issues. When a user can be categorized into more than one category of users, it is known as the "**grey sheep**" dilemma. The recommendations he will receive are erroneous since this user shares an identical degree of similarity with two or more groups. We have limited content analysis and over-specialization in the area of content as we have studied it from research [2].

A knowledge-based recommendation system was developed to address the shortcomings of earlier approaches. The advantages of knowledge-based systems include the avoidance of the cold-start problem, the new item problem, and the grey sheep problem. If we use knowledge-based recommendation system there will be no need for big historical data collection; and more trustworthy due to the absence of noise in the domain

Knowledge as we have learned it from research [4].

There wasan existing location-based recommendation system which was based on content and collaborative filtering which was done by [3].

As there are drawbacks for content based and collaborative filtering so we want to overcome all the drawbacks and implement the system using knowledge-based filtering as we have learned it form research [4].

Problem Identification Andobjectives

The Problem:

In recommendation systems, the most likely used filters are collaborative filtering and content-based filtering. They have several drawbacks, such as the fact that the model can only suggest content based on the user's current interests. To put it another way, the model has a limited capacity to build upon the consumers' already established interests. We face issues with sparsity and the grey sheep dilemma in collaborative filtering [4].

Users with distinctive likes and tastes are referred to as having the "**grey-sheep dilemma**," which makes it challenging to create precise profiles. In other words, the similarity search strategy commonly used during the recommendation process doesn't produce satisfactory results.

The **sparsity problem** is a significant issue that restricts the effectiveness of suggestions and the wide applicability of collaborative filtering. It arises when transactional or feedback data is sparse and insufficient for identifying neighbors.

The Proposed Solution:

We use knowledge-based filtering to get over the issues with collaborative filtering and content-based filtering. A particular kind of recommender system that is based on explicit knowledge of the item selection, user behavior, and suggestion criteria is known as a knowledge-based recommender system. The absence of cold start issues is a key benefit of knowledge-based recommender systems. Since a big data collection is not required when employing the knowledge-based technique, the **cold-start**, new item, and grey sheep problems are also avoided.

Objectives:

1.The main objective of this project is to recommend locations accurately.
2.To improve accuracy when compared to existing ones we are trying to implement clustering algorithms.
3.By using K-means it is used to increase theperformance and great scalability.
4.It is going to reduce the time complexity of finding a location.
5. We are using a web page so it is easy for the user to use it and find the recommendations easily.
6. We are also recommending hotels so it is easy for the user to find hotels and stay[8].

SYSTEM DESIGN

Proposed System Architecture

This is the model as the user wants to travel from one location to the other location. So using knowledge based recommendation system we want to recommend the user to move from one location to the other location. To recommend the user through KBRS we just have to know the user's location so through that we have to apply the algorithm. Since K-means clustering is one of the most well-liked unsupervised machine learning algorithms, we want to use it [6].

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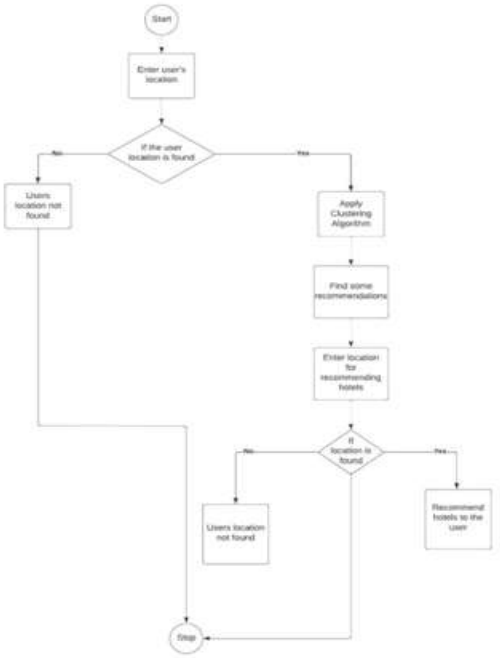
Proposed System Model:

First, we have to find the user's location. After that we have to enter the user's location. Then we can apply clustering algorithm like K-means clustering after using the algorithm we can recommend the location's to the user.



SOFTWARE REQUIREMENTS

Requirements:

- Any operating system that will support OpenCV and Python (Windows, Linux, MacOS)
- Python
- location dataset
- Data exploration

Tools:

- Scikitlearn
- Numpy
- Pandas
- Matplotlib
- Seaborn
- Geopy

III. METHODOLOGY

The most important thing for recommending a location is the user's location and to recommend we have to use an algorithm. The algorithm used here is the K-means algorithm. Location Recommendation is the geographical information of places which is utilized by traditional online social networks like Facebook and Twitter to display and recommend forthcoming events, updates, and local patterns.

ALGORITHM

What is clustering?

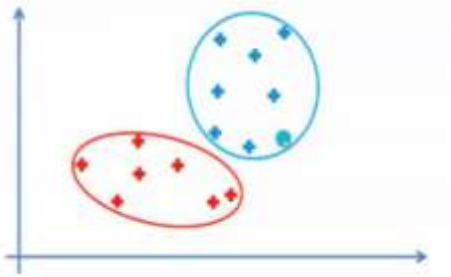
Clustering Algorithm is an unsupervised learning algorithm. Clustering algorithms separate the population or data points into a variety of groupings to ensure that the data points within a cluster are more similar to one another than to those in other groups. Essentially, the objective is to group people into clusters based on their shared traits.

In this procedure, the items are divided into k clusters with the goal of making each cluster's constituent items as similar as possible to one another. Additionally, things outside of a cluster are as distinctive as feasible.

Euclidean Distances between the data points are used to determine how similar and dissimilar they are. There is a centroid for each cluster. The point that best embodies a cluster is known as its centroid.

How K-means clustering works?

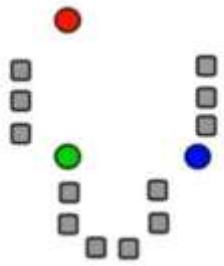
K-means clustering performs the grouping process in an iterative manner. The following are the steps this algorithm takes to operate:



STEPS TO IMPLEMENT ALGORITHM:

Step-1: choose the number K (in the case=3) of cluster

Step-2:Select at random K points , the centroids.



Step-3: Based on Euclidean distance or Manhattan distance, assign each data point to the nearest centroid. This results in K clusters.

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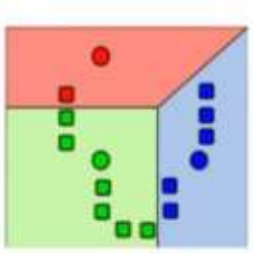
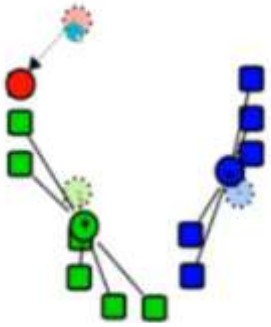
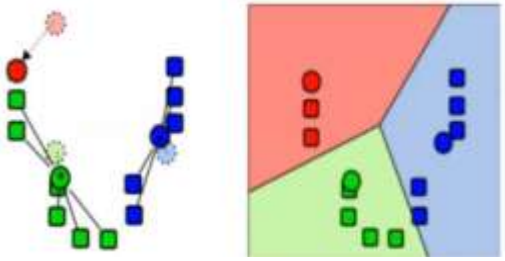


Step-4: Calculate and position each cluster's new Centroid. The new mean is determined by the centroid of each of the K clusters.



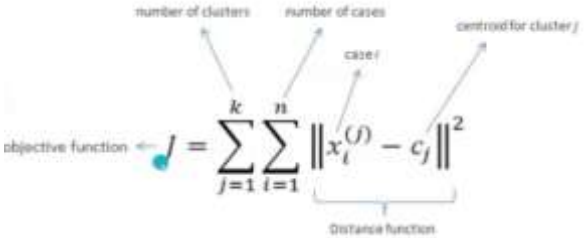
Step-5: Each data point should be reassigned to the new nearest centroid. If there was a reassignment, go to step 4.



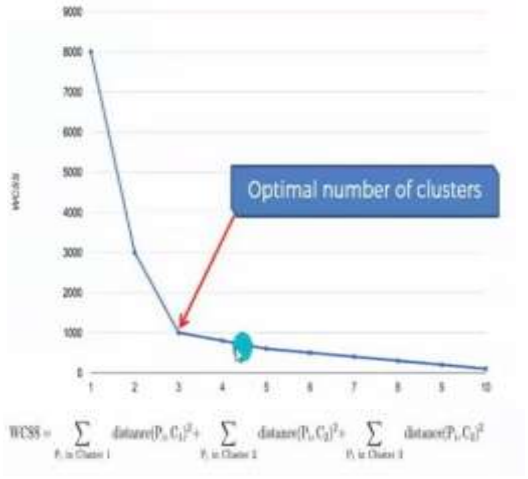
Choosing The Optimal Number Of Clusters: There are a number of ways to choose the optimal value for K to achieve the best results from the algorithm. Some of these methods include:

- Silhouette Method
- Cross-Validation
- G-means Algorithm
- Elbow Technique

Here, we'll use the elbow approach to determine K's ideal value.



The variation in the data points is calculated using the Within Cluster Sum of Squares (WCSS). The algorithm's objective is to reduce this value.



Here Since number 3 in the graph above has an elbow form, we may say that K=3 is the number for the ideal number of clusters.

IMPLEMENTATION

We are creating a web page in which we have to login as some users have different kind of opinions so we have created a login page. After the login page we will have two options in which one option is for hotel recommendation system and the other option is for location recommendation system. It will be easy for the user to use our webpage and we can easily recommend the locations as well as hotels[7]. We are using VSCode as our python compiler and flask which is used for front end and backend connection and Bcrypt is used for security purposes. We have used MongoDB for the user database and for location recommendation system we have created a dataset manually and for hotel recommendation system we got a dataset from goibibo.

VSCODE:

Microsoft's Visual Studio Code, sometimes known as VS Code, is a source-code editor which is used for Windows, Linux, and

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macOS that uses the Electron Framework. It is used for supporting debug processes and it is used for syntax highlighting and it is intelligent code completion and it is used for code snippets and it has a high code refactoring, and embedded Git are among the features. Users can modify the theme, keyboard shortcuts, preferences, and add functionality by installing extensions.Python, Java, C++, JavaScript, and many other languages are supported by VScode. We used VScode because it is very useful for software development in these days. VScode is very useful because it can connect all the dataset and database very accurately compare with other compilers. In VScode we can also write HTML,CSS code as it supports all languages compare with other compilers. Our project is web based as well as machine learning so VSCode supports python as well as HTML and CSS. We can easily import all the files and tools in VScode.

FLASK:

A Python package called Flask serves as a web framework that makes it simple to create web apps. Its core is compact and simple to extend; it's a microframework without an object relationship manager or similar capabilities. It does have a lot of great features, including a template engine and URL routing. It is a web app framework for WSGI which is a web server gateway interface. In our project we used flask to connect the machine learning code and the web application. We have used K-means clustering for location recommendation system as well as hotel recommendation system which is our machine learning. The login page and home page and the two options for selecting is our webpage. For the two options we have to connect the machine learning so to connect the backend and front end we have used flask.

BCRYPT:

Passwords are securely hashed and salted using the BCrypt Algorithm. In order to protect against long-term risks or threats, such as attackers having the computational capacity to guess passwords twice as rapidly, BCrypt enables establishing a password security stage that can advance local hardware innovation. In our project we used Bcrypt for security purposes as it is used in login page. If the user has given a wrong password, it will give a warning. Once a user register through our webpage we will store the password in our mongoDB. If the user gives a wrong password, it will show that is wrong. It is necessary and it is useful for a webpage to have security.

MONGODB:

An open-source of NoSQL database management system is called MongoDB. Traditional relational databases can be replaced with NoSQL (Not only SQL) databases. Working with sizable distributed data sets makes good use of NoSQL databases. MongoDB is a technology that can manage, store, and retrieve information that is document-oriented. In our project we have used MongoDB as it is used for the user's database and it is a online database as it is going to store the credentials of the user. For location and hotel recommendation system we have used some datasets. ForLocation recommendation system we have created a dataset manually and for hotel recommendation system we have used dataset from goibibo.

Steps for K-Means Clustering algorithm on location dataset:

Step-1: We have to import all the libraries and packages such as Numpy, Pandas, Matplotlib, seaborn, scikitlearn, seaborn, geopy.
Step-2: We have to import the dataset which will be downloaded from Kaggle(location dataset).
Step-3: We mentioned the country name INDIA and in that country, we are taking some City names.
Step-4: Convert to latitude and longitudes with the help of "geolocater.geocode".
Step-5: In this step we are creating a longitude and latitude list.
Step-6: Applying KMeans algorithm to form clusters.
Step-7: Since, we have 5 directions in the map East, West, North and South and Center.

Step-8: So we have choosen the K-value as 5.
Step-9: Here in this recommendation system we are forming 5 number of clusters and each cluster contains similar type of data.
Step-10: That means By calculating the Euclidean distance or manhatten distance we will form 5 clusters.

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$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$

Step-11:Compute and place the new Centroid of each cluster. The centroid of each of the K clusters becomes the new mean.

$$\overline{X} = \frac{\sum X}{N}$$

Step-12: After that We are taking the user input or based on previous location the system recommends some places.

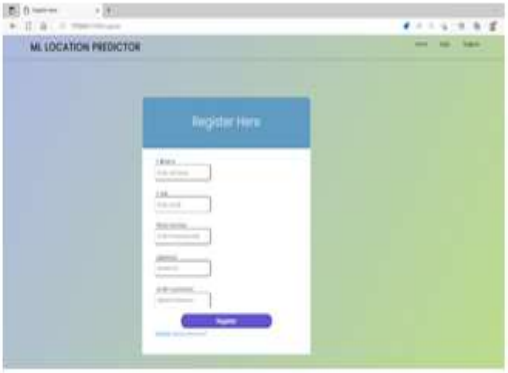
OUTPUT SCREENS

This is our login page and if you have already a user you can login otherwise we have a option to register.

This is our registration page.You can register from here.

After registration you can login by typing your username and password.

After your login page we will get a home page and in this page, we have two options which is "Get hotel prediction" and "Get location Prediction". To recommend tourist places you can use the option of "Get location Prediction". To recommend Hotel places you can use the option of "Get Hotel Prediction".



After clicking the option of "get location prediction" we will get a page like this and it is used for tourist places.

After clicking on submit we will get the tourist places as I have searched about Visakhapatnam, we will get the tourist places of Visakhapatnam.

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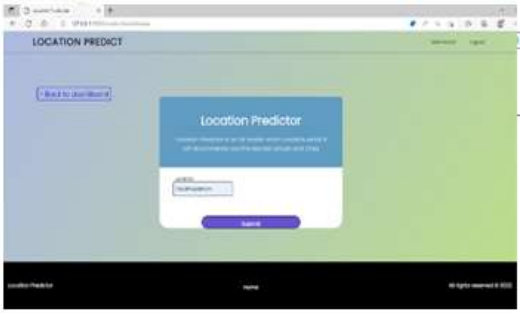

After clicking "get hotel prediction" we will get a webpage like this and it is used to produce the hotel recommendation. As I have given the location as Visakhapatnam, we will get the hotels of Visakhapatnam.

We will get the hotels of Visakhapatnam as it is showing the rating and address and hotel description.

IV. CONCLUSION

In our project we are using knowledge-based filtering and K-means clustering algorithm. By using this clustering algorithm, we are trying to improve the accuracy and making the recommendation more efficient and maintaining speed than the existing ones.The user that enjoys travelling is the one we want to recommend a place to, and we will do so based on the user's current location. As Knowledge based it is a particular kind of recommender system that is based on explicit knowledge about the item assortment, user preferences, and recommendation criteria, we are employing knowledge-based recommendation systems. To determine the longitude and latitude of cities that are included in our dataset, we use "geolocator.geocode" in our project. Now that we have the user's input, we need him to provide hislocation so that we may suggest various locations to the user.

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