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Recommendation Systems for Community Commerce

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Abstract
Recommendation systems have become very important for any application nowadays. In this paper, we have researched many such state-of-the-art techniques in the field of advertising and recommendations through various implementations. Applications of such multiple techniques are also discussed along with their limitations. Implementations in the domains of artificial intelligence, the semantic web, IoT, etc. have been studied thoroughly. Important issues like finding the right products for customers and marketing a product to the exact type of customers have been identified and solved with the help of a proper recommendation system. Various models along with their merits and demerits have been studied. This paper also thoroughly explains about the challenges faced by the various models and their respective algorithms which provides an efficient recommendation system to the users. Apart from this a literature survey has also been done taking reference from multiple papers and summarising their outcomes and summing up into this one survey paper. The Internet across the world is filled with millions of data wherein the number of choices is enormous which produces a need to filter, hierarchize, personalize and structure the data so that information overload problem can be deadened.

Keywords:-Recommendation system, Hybrid system, personalized advertisement, Collaborative filtering, and Content-based filtering.

I. Introduction

The recommendation system provides suggestions to users to make a quick decision by giving the best recommendation possible. It makes users sort through large products, make decisions by eliminating non-suitable products by users' preference and potential demand for the product and overcome information overload. E.g., Netflix uses its recommendation system to provide users with mostly watched videos; around 80% of watched videos were recommended by the system. Also, the Reddit system provides the best advertisement to the user by sorting the most visited, popular ads.

A recommender system can be built by getting user data as much as possible. User information like attributes, behavior, and interest can be acquired by their history, explicit feedback, purchasing history, and rating. After getting user interest the system can filter out by various techniques, and methods and provide products that users may like.

This survey was done to find the most optimal solution for our application: Community commerce. This application is a community based social media platform where people can create communities and post into these communities. Recommendation system is required in this application to advertise products, based on the communities a user has joined.

II. Objective

This work aims to provide a systematic review in the field of community commerce to collaborate with other communities and help them grow and design a framework that could be adopted by the commerce community.

Upon analysis of the literature, the following question will be answered:

a. What techniques, methodologies, models, and approaches are used to achieve a personalized advertisement?

b. What kind of issues, challenges, and limitations exist in this domain?

c. Which recommendation system is best for e-commerce?

III. Literature Survey

Many recommendation systems were proposed by various researchers to provide better customer advertisement services. The surveyed papers for advertisement recommendation systems are as follows:

Fan Yang [1] proposed designing and implementing an intelligent business recommendation system based on a hybrid recommendation algorithm using a content-based recommendation algorithm, an item-based collaborative filtering recommendation algorithm, and a demography-based recommendation algorithm. The system was made in such a way that it can resolve issues like lack of user and item information and proposed a better recommendation system.

Xuesong Zhao's [2] paper commonly discussed three algorithms like Collaborative Filtering, Content-based Filtering, and User Clustering Models, and the challenges in big data and provide a recommendation system based on Hadoop.

BogdanWalek and Petra Spackova [3] proposed a recommendation system based on a content-based model for online shops. The main objective of the paper is to provide customer-centric advertisement and to minimize the effect of the cold start effect i.e., the system cannot predict any advertisement for the customer for which information is yet to gather.

Lu Zhang, JialieShen, Jian Zhang, JingsongXu, Zhibin Li, Yazhou Yao, and Litao Yu [4] paper analyze the purpose behind the information spreading over social media platforms. A model is proposed i.e., a Multimodel-based Marketing Intent Analysis System (MMIA)

IosifViktoratos and AthanasiosTsadiras [5] analyze the previous literature in the field of personalized advertisement and proposed a framework based on the research to provide a better advertisement to attain a certain level of targeted marketing.

NayanabaGohil's [6] paper proposes many techniques to detect and analyze Click-Fraud, botnets, and Click-farm like traffic analysis, data mining, Machine Learning, Honeypot, etc.

Mohammad Daoud, S.K Naqvi, and Asad Ahmad [7] system assist online or goal-oriented shoppers by suggesting the most effective navigation products for their specified criteria and preferences. Paper uses text-mining techniques to capture opinions and product information and their identical attributes over social media.

SEONGJU KANG, CHAEEUN JEONG, AND KWANGSUE CHUNG [8] purposes a real-time tree-based recommendation system it generates a tree model based on the user's past search history. Sorted HashMap is used that lets fast searches that eventually reduce the running cost of prediction. According to the tree model's nature, the user's preferences are normalized by the system.

Zhihua Cui, XianghuaXu, FeiXue, XingjuanCai, Yang Cao, Wensheng Zhang, and Jinjun Chen [9] proposes a recommendation system on the basis of user information. It uses the CF algorithm which checks users' patterns and their way of searching and accordingly provides the recommendation.
Lei Deng, Jerry Gao, and ChandrasekarVuppalapati's [10] paper propose a framework that provides both offline and online ways of advertising based on the techniques of analysis which eventually recommends advertisements. The advertisements are recommended according to the big data which is being collected regarding search patterns, behavior, etc.

IV. Proposed Work

With taking multiple references from various internet sources and our knowledge we created a project whose title is Community Commerce to Collaborate, Connect, and Grow which is a social networking web application in which users can create their accounts and can form communities and can share posts which match with the interests of the other users in the community. At current state users can upload text and image as a post. This post will be visible to the users who are the part of this community to which this post has been shared. People who are getting this post, they can comment down their views under this post and to which other people can reply. There is another feature of agreeing to the comments of other users by upvoting to their comment and vice-versa.

Tech-Stack

TypeScript:
TypeScript is a programming language which is perpetuated by Microsoft and is a free and open source language. It is JavaScript's superset which is strictly syntactical which also has the feature of adding an optional static typing to the language. It is generally used to build large applications.
Next.Js:
Vercel is a cloud platform service based company which created an open source web development framework which is known as Next.js. It is basically a framework of react which enables features like server-side rendering and has the capability of creating static websites. Next.js was initially released in 2016 on GitHub as a free project on which any one can contribute freely.
Firebase V9:
Firebase is a cloud-hosted realtime database in which data is synchronized simultaneously with every client and is stored as JSON. It is basically a Google's product with the help of which software engineers can develop or build their applications easily. Firebase provides security related features to the developers and also no coding is required which eventually makes it easy to use. It can provide services and facilities to web, unity, ios, android etc. For the storage purpose it makes use of NoSQL.
Chakra UI
It is a component based library which is used to enhance or beautify the react applications. It lets us use the reusable and composable React components. It's basically used to make the front-end of our website or application.
It basically supports React.js and some other libraries also. It becomes extremely easy to use if we know the correct usage of React.js components. We can say that it is an alternative to CSS and it maps to nearly all the vital CSS functions and properties which are there for use.

Recoil

It is a state management library for React. Recoil keeps a track and ensures that only those components are proffered which are following that atom. With only React it is somewhat difficult to achieve some capabilities but recoil makes it possible. As already mentioned Recoil is a library written by Facebook to handle states in React. Although it is in its initial or early stage, but it looks promising and loaded with components and features which convinces any developer to use Recoil with React.

V. Recommendation systems techniques

1 . Content-based recommendation system

In order to implement content-based recommendation systems, the data provided knowingly (such as ratings or reviews) or unknowingly (such as visits to links) is taken into account. Data profiles of users are being created to enhance recommendation quality.

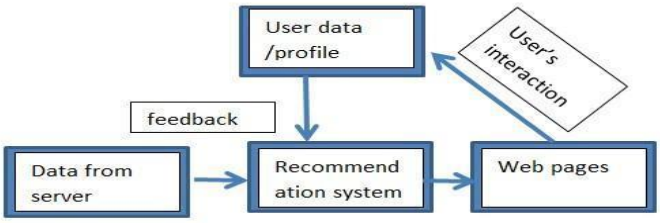


Fig1:Content-Based Recommendation System

There are three parts to this recommendation system's categorization. To begin, common terms are collected for each topic, then similarity ratios are calculated, and at the end, user preferences are recognized [1].

For the mentioned system, two methods were proposed. Plotting the cosine method between the users and their utility matrix can be done. Alternatively, a decision tree can be built with criteria on each step to rectify results using classification techniques [1][2].

2. Item-based collaborative filtering recommendation Algorithm

Discussing item-based collaborative filtering methods, it predicts the choice of user and evaluates the products which users almost like with the help of rating or preferences provided by different sets of customers (users). Considered fact is if two users have some preference about some product then chances of having same preferences for other products is high [1].

Two step approach is used for implementing CF recommendation algorithms. Finding the similarities between products by pairing each product with one another. Vector form is introduced to conclude the similarity. At the end, the missing rating will be calculated[1][3].

3. Demography-based recommendation Algorithm

Demography-based recommendation utilizes demographic attributes like age, gender, ethnicity, etc. to propose recommendations to new users. Initially, the personal data of the user is collected. Then data is broken down separately according to the demographic characteristics measured.The

constraint of product ranking of popularity is eliminated[1]. The core of this approach is to establish a correlation between users.

4. Collaborative filtering algorithm

Traditionally it is a machine learning technique and one of the ways or methods with the help of which automatic prediction or filtering can be done very easily. Automatic prediction is majorly about the interest of a user and this prediction is done by gathering the taste or information which would be in favour of users.

It is basically a cluster of algorithms in which similar users could be find through multiple ways and also there are different options to infer rating-based results. Currently this algorithm, which is a collaborative filtering algorithm, is used in many online platforms like Amazon.

For example if a person orders products from Amazon, post that product's delivery the account holder will be suggested with the similar kind of products on his Amazon feed based on his previous ordered products. This algorithm makes intelligent decisions and provides the user with the best product which is related to the previous products or based on the previous products ordered by the same user on Amazon.

A collaborative filtering algorithm provides permission for unexpected or fortuitous recommendations. In this type of filtering algorithm, we don't use that privilege or facility of proposing an item to a user but the best way is to divide the users into different groups having the same interests and then advocating or proposing each user on the basis of the interest of its group. This filtering algorithm is most popularly and widely used in news media, e-learning and last but not least E-Commerce websites and applications.

This algorithm majorly suggests to the user about the best item, product, hotel or movie not on the basis of an individual user's ratings but it takes care of the ratings given by multiple users and out of that the common item which is liked by both the users is eventually recommended by this algorithm.

Types

This algorithm is further bifurcated into two separate algorithms the first one is item-based collaborative filtering recommendation algorithm and the other one is a user-based collaborative filtering recommendation algorithm.

The first one that is item-based collaborative filtering recommendation algorithm also known as K nearest neighbour collaborative filtering, is used majorly by many of the successful E-Commerce websites and other online platforms which require an efficient recommendation system. It is that much more efficient algorithm that it can produce Mini suggestions and can advocate many items per second for millions of users. This subcategory algorithm first of all does the analysis of the user item matrix which helps in getting the connection across various items and then eventually uses this connection to indirectly reckon suggestions for the user.

The second one is the user based collaborative filtering algorithm. The way in which item based collaborative filtering algorithms are popularly used and is very successful in the same way user based filtering algorithm also has the widespread use and is implemented by the many famous online platforms. In this sub-algorithm, a different methodology is used to do the predictions of the items. The items which are predicted are mostly on the basis of the ratings or scores given by

various users to that particular item and on the basis of these scores an item is suggested to the target user.[1][2]

Problems of user based collaborative filtering algorithm

The first problem faced by this technique is expandability and the second one could be paucity which means a shortage of something. For example on Flipkart, there are millions of varieties of shoes provided by various brands but only two or three per cent of types are popular or bought by a maximum number of users. So, in this case, recommendation of a system which considered a large set of data or items may miss out on the shoes which do not come under these 2% to 3% and eventually the system will not suggest the remaining 97% to 98% of shoes to the nearest neighbours of the current active buyers on Flipkart.[5][7][8][9]

5. User Clustering Algorithm

The aim of the user clustering algorithm is to recognise and connect users in different groups with respect to the changing degree of complexity in the wide variety of available information. It is basically used to do the analysis of data to get the different hidden patterns and behaviours of data like clusters of customers on the basis of their interest and their behavioural pattern. This methodology or algorithm comes basically under an unsupervised method wherein the non-labelled input is provided to the algorithm and the issue is solved with respect to the experience which the algorithm gets by dealing with the same kinds of issues during training.

Clustering also known as cluster analysis helps in combining items on the basis of resemblance and also lets together data points on the basis of likeness.

Types of Cluster Models

One type of cluster model is hard clustering in which the data points completely are part of the group or that cluster or they are completely not part of that cluster.

Another type is soft clustering in which light hoods or possibilities play a major role. In this data points are given with the likely score to be in that particular group, bunch, or cluster.[2][9][10]

6. Tree Based-Model

Tree base model is a model of machine learning which is used for bifurcation as well as regression problems. This model makes use of a decision tree and this helps in deciding how the various input variables are used to forecast a target value. This technique is usually used as a data mining method to generate bifurcation systems on the basis of various control variables or to make prediction algorithms.

Basically the decision tree is similar to any other tree which consists of root node intermediate nodes and the leaf nodes. This type of model comes under the supervising machine learning algorithm category which makes use of many numbers of decision-making statements to divide the training data into various subspaces. Further, every subspace contributes vital complexity to the model which eventually helps to do the predictions.

Challenges faced by a tree base model

Basically decision trees are susceptible to a problem in data mining when random variations in data are mis-classified as important patterns and this problem generally happens when the function is a very much closer fit to the training data. Another challenge could be high variance as decision trees

suffer a lot from the same. Three phase model generally gives varying results when the data set is small and this depends on how the training and testing samples are segregated.[8]

Ways of coping up with overfitting

To decrease overfitting there are a variety of ways in which there is a need to prevent the model from grabbing or capturing the patterns which happen to be too specific and turn out to be complex. This can also be called as early stopping or pre-pruning which consists of three sub-points which state that the least number of samples for a note split should be there and the depth of the tree should be maximum along with the features which are considered for segregating should be maximum in number.

Apart from this some other methods like pruning also known as post tuning work on the principle of removing leaf nodes that do not contribute to the predictive potential of the model which helps to simplify the model and avoid or reduce overfitting. Another technique is bagging or bootstrap aggregation which helps in reducing the variance of predictions which takes consequences from a variety of decision tree models. In this category, random forest is a widespread used machine learning algorithm. This algorithm not only randomly samples the training date of each tree but it also does the same thing with the features which have been embedded within each tree.

7. Time-Aware Collaborative Filtering Model

Collaborative filtering is the most used technique for any recommendation system because it Sorts out the things that users may like based on the behavior of the other users. But what will happen if the user behavior may change according to time the previous collaborative filtering may not have worked in this scenario. So, a new approach is introduced to solve the above issue i.e., Time-Aware Collaborative Filtering Model.

Traditional Collaborative Filtering only uses user information to make a recommendation system, but new users and items keep entering the system which changes users' information therefore to keep up with new emerging data models need to train. The collaborative filtering model considers both neighborhood-based and SVD (Singular Valued Decomposition) models.

Time-Aware neighborhood model: Adopting time-aware in the neighbor-based model is to give more attention to recent behavior than past ones. And this can be obtained by the discrete time windows function technique.

The time-window algorithm considers data only in a window. E.g., For a certain video, there are the top 100 watchers, or the time window can be obtained by a recent time interval. A user-based neighborhood algorithm is proposed that will compute the correlation between the new window users.

Time Aware Factorization model: A factorization model has been recently added to collaborative filtering to manage temporary effects. In order to solve this problem an optimized SVD algorithm is being proposed to stop these effects. To tackle the effects, user and item biases are to be computed in real-time. For the item bias, it can be calculated using the time window which a user wants. For the user bias, it can be solved using the decay function which will use another user's past behavior and calculate the result.[8]

8. Hybrid Filtering Model

It is a model which is a combination of two models i.e., content-based and collaborative filtering models to give an optimal recommendation to a user. This type of model overcomes both models' issues i.e., the content-based model cannot give a solution over users' new preference, and in the collaborative filtering model based on user and item if a new user or item is added it cannot provide a solution over it.

The first Hybrid recommendation was created using pure collaborative filtering. These models are then used as input for CBF. Likewise, Pure-CF >CBF, CBF separate>Pure-CF, CBF>Pure-CF combination can be made to generate more recommendations.[1][8]

9. K- Nearest Neighbor Model

This method was introduced in the 1950s but was not popular until increased computational power became available because this method needed a large set of data for training. Nearest Neighbor works by giving a sample test and training tuples that are like it.

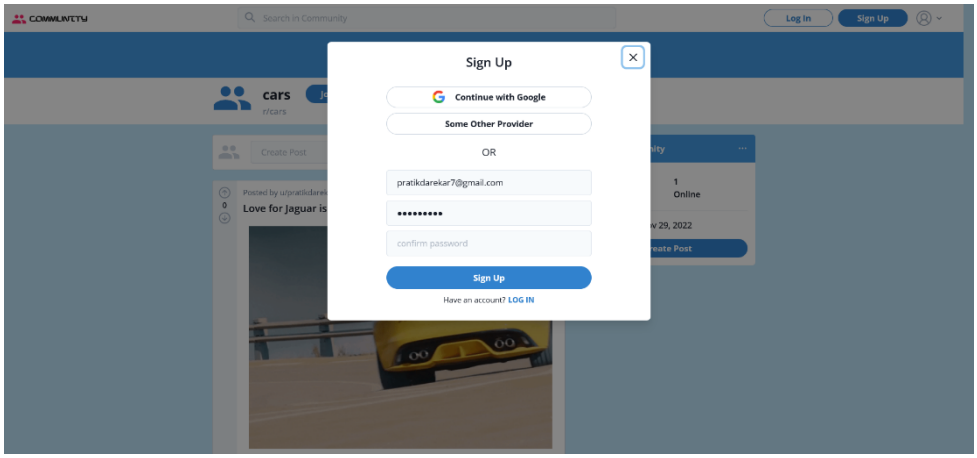
The training tuple is identified as n sets. The training tuples are placed in an n-dimensional space where each node/training tuple is recognized by a user. When a sample test tuple is given to the model it will find the k node has the most similar attribute to the given sample test tuple and this k node represents a node having similar attributes to the sample test and is the k-nearest neighbor of the unknown tuple. To find the closest node among n nodes in pattern space is to find the distance between those nodes; this can be done using the Euclidean or Manhattan approach.[10]

Sr No.	Model Name	Advantages	Disadvantages
1.	Content-Based Recommendation Algorithm [2]	1.Data from other users is not required as it is based on specific user preferences. 2.This provides niche preferences to users. [1]	1.The user-engineered approach is used which needs more domain knowledge 2.Can't predict the future interest of the user.
2.	Item-based collaborative filtering recommendation Algorithm	1.It is not necessary to have prior domain knowledge. 2.Model can find new interests for the user.[1][3]	1.The problem of cold-start occurs as it is impossible to provide recommendations to new users.
3.	Demography-based recommendation Algorithm	1.Mostly used recommendation system. 2.Due to the similarity in age, and ethnicity it is highly trusted regarding the recommended product.[1]	1.New users can't get a proper recommendation as such if demographic information is missing 2.Sparse data is one of the issues.
4.	Collaborative filtering Algorithm	1.No domain knowledge necessary. 2.Serendipity.[7]	1.Scalability 2.Sparcity[9]
5.	User Clustering Algorithm[2]	1.Relatively simple to implement. 2.Scales to large data sets. 3.Guarantees convergence. 4.Can warm-start the positions of centroids.[9][10]	1.High time complexity, not suitable for very large data set, and the clustering result sensitive to the parameters involved in AP algorithm 2.The cluster uses the same IP address for Directory Server and Directory Proxy Server, regardless of which cluster node is actually running the service.
6.	Tree-Based Model	1.Easy to represent visually, making a complex predictive model much easier to interpret. 2.Require little data preparation because variable transformations are unnecessary.[8]	1.A small change in the data can cause a large change in the structure of the decision tree causing instability. 2.Sometimes calculations can go far more complex compared to other algorithms. Decision tree often involves higher time to train the model.

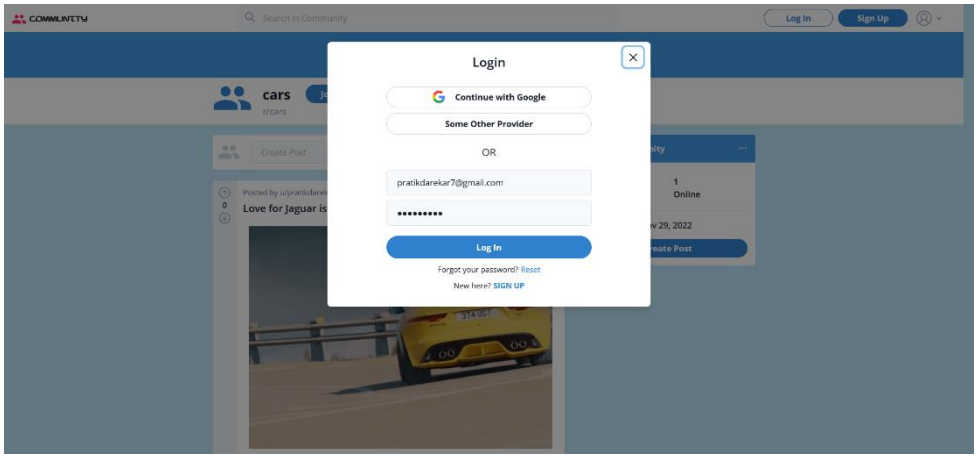
7.	Time-Aware Collaborative Filtering Models	1.Give a real-time recommendation to user 2.The model itself trains itself by time window or delay function.[8]	1.Since it is a new emerging topic but the real world still uses static CF. 2.Online evaluation, performance, and scalability are the main issue.
8.	Hybrid Filtering Model[1]	1.Increases the performance and accuracy by adding both content-based and collaborative filtering models 2.Increased flexibility on adding more data[4][8]	Classifier specific methods. Dependents on the combination of different feature selection method.
9.	K- Nearest Neighbour	1.No training is required because data act as a model 2.Implementation is easy the only thing is to calculate a minimum distance between after finding out the suitable k nodes. 3.As there is no training adding a new node does not affect the model.[10]	1.does not work effectively with large data. 2.since nodes are present in n-dimension increasing the value n results in difficulty in finding out the distance between nodes.

VI. Result

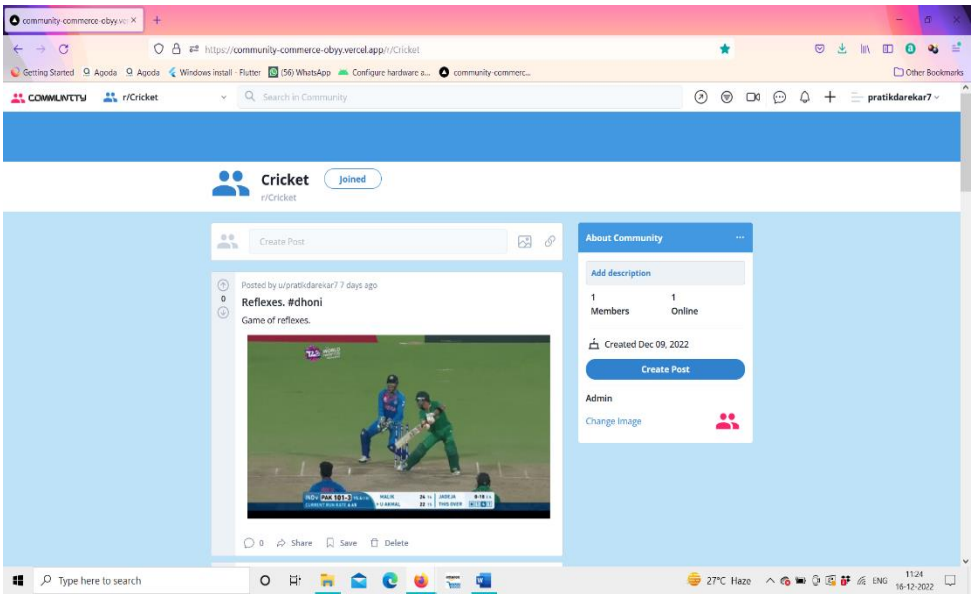
Sign Up Page



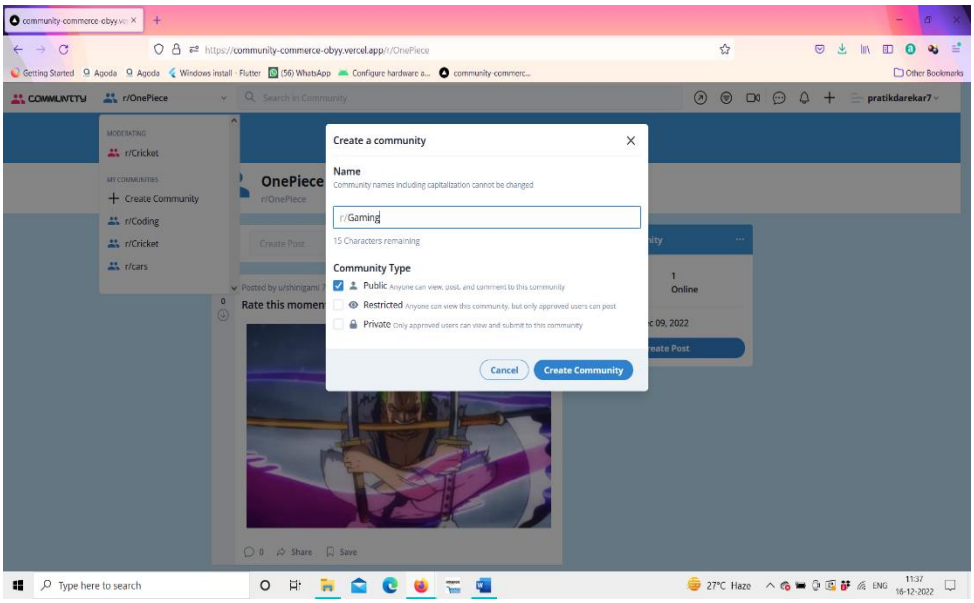
Login Page



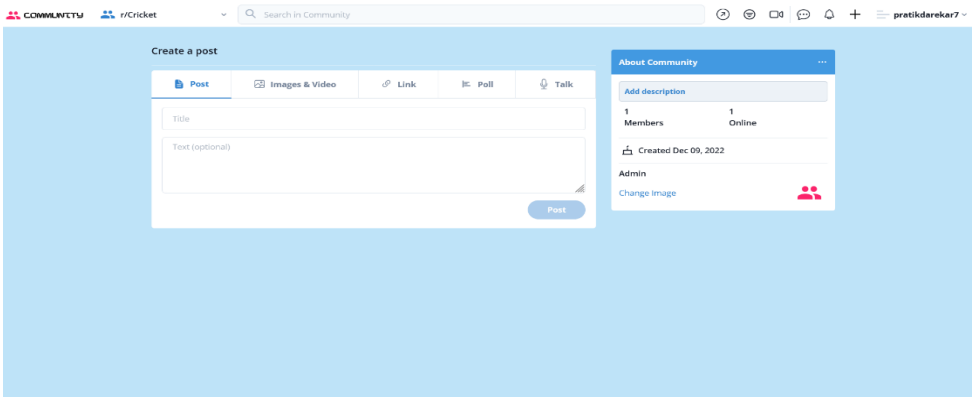
Home Page

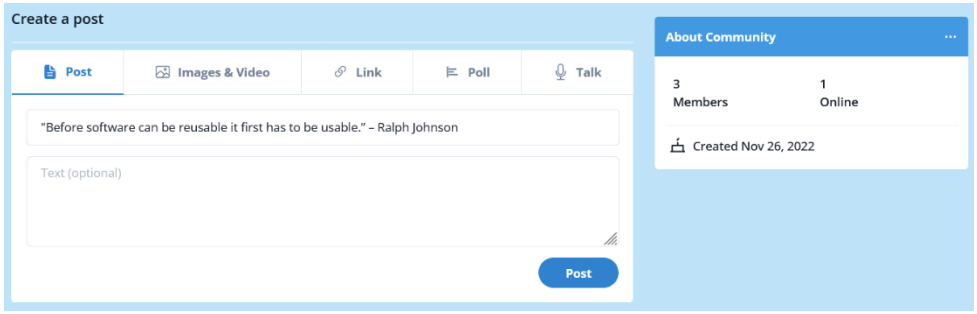


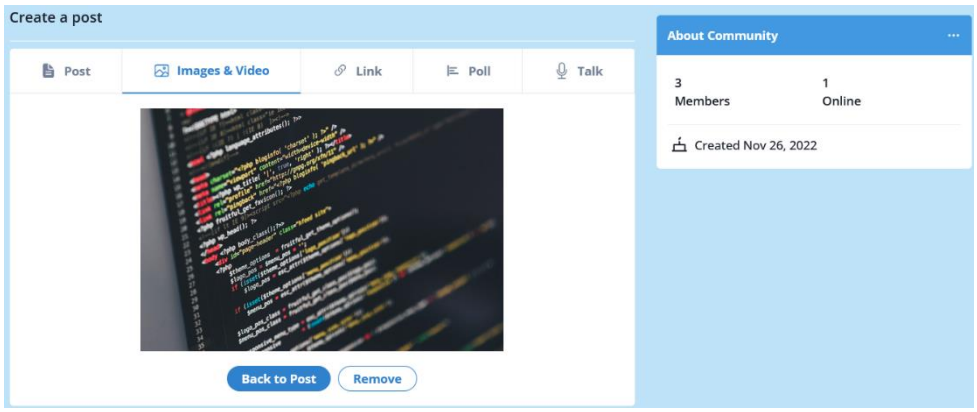
Create Community Window



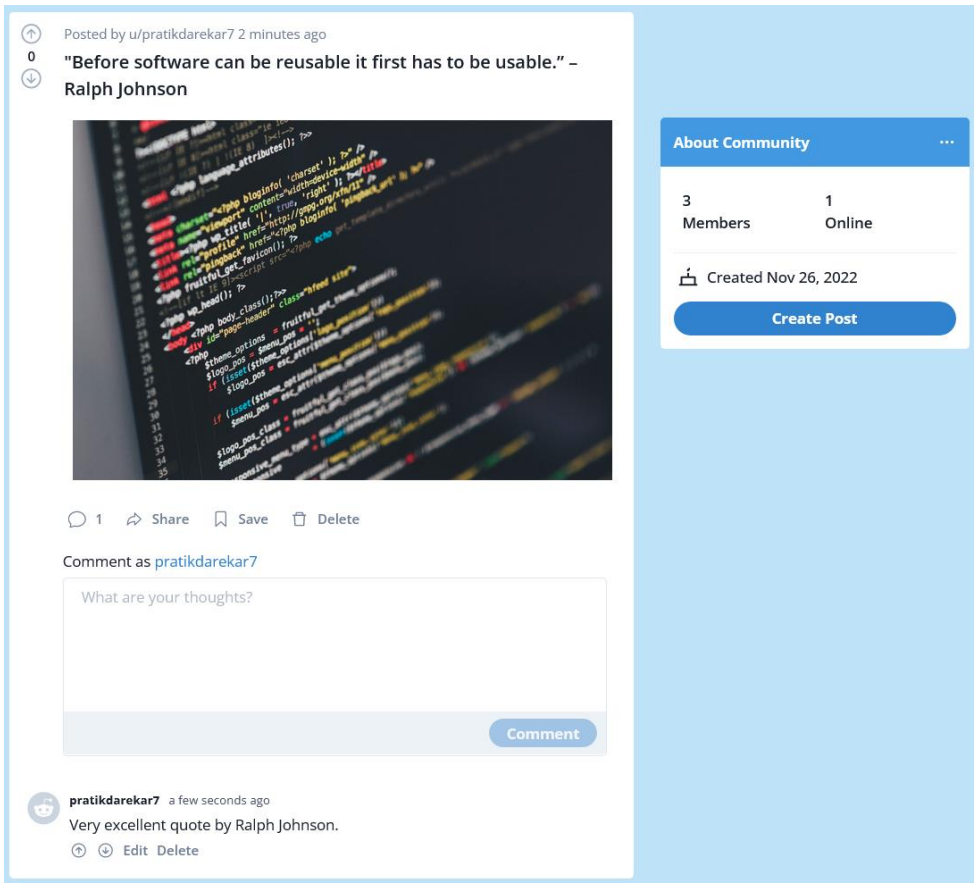
Create Post Window







Post Created



VII. Conclusion

In this survey paper we studied various models for recommendation systems. Various models and algorithms were discussed like hybrid recommendation systems, personalized advertisements. Recommendation systems can be made by combining various models like content-based, collaborative filtering algorithms which provide more personalized content to the user. Emerging new data and items leads to models that can predict more suitable items/advertisement recommendations to the user.

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