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Exploring Friend Recommendation Algorithms in Social Networking Sites

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Abstract- Friend suggestion is a highly popular feature in social networking platforms, designed to connect users with similar or familiar individuals. This concept, rooted in social networks like Twitter and Facebook, often utilizes a "friends-of-friends" approach, where users are introduced to connections through their existing social circles. Traditionally, users tend to connect not with random individuals but rather with acquaintances of their friends. However, existing friend recommendation methods have limitations in scope and efficiency. To address these limitations, we propose an enhanced buddy recommendation model. Our approach leverages collaborative filtering to improve accuracy by analyzing users' similarities and differences based on their interests, activities, and preferences. Additionally, location-based friend recommendations have become increasingly popular as they bridge the gap between the physical and digital worlds, offering insights into users' preferences and interests. This model will expand the range of recommendations, connecting users with others who share similar interests and reside in similar areas.

Index Terms- Friend Recommendation, Collaborative Filtering, Social Network, Recommendation System.

I. INTRODUCTION

Friend recommendation is one of the core services in location-based social network (LBSN) platforms, connecting users with familiar or like-minded individuals. By 2017, 71% of internet users engaged with social networks, a figure projected to continue growing. Social networking remains among the most popular online activities, characterized by high engagement rates and expanding mobile capabilities. The widespread adoption of smartphones and mobile devices has further accelerated the growth of mobile social networks, enriching them with new features.

Facebook, with over 1.86 billion active monthly users, currently leads the market in terms of reach and user engagement. Recent advancements in localization techniques have enhanced social networking services, enabling users to share locations and location-based content. These platforms, known as location-based social networks (LBSNs), bring together the digital and physical worlds, providing deeper insight into user interests and behaviors.

Our proposed recommendation system aims to leverage user profiles, interests, and location histories, applying collaborative filtering techniques to increase the scope and efficiency of friend recommendations. This approach allows for more relevant user-to-user suggestions by focusing on shared interests and locations, creating a more engaging and personalized experience.

1. Recommender Systems

A recommender system is an information filtering tool that predicts the preferences a user might have for various items, helping streamline their choices. With the growth of e-commerce, recommender systems have made it easier for users to quickly find products that match their interests without extensive searching. Websites like Amazon and eBay are prime examples, offering personalized recommendations based on users' search and purchase histories. These systems span a wide range of items, from books and movies to music.

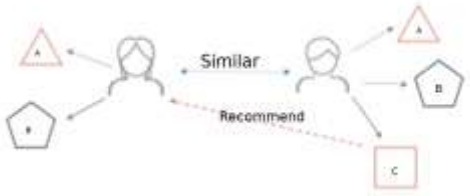

Figure 1:Recommender System

Social media platforms such as Facebook and Twitter also use recommender systems, providing friend suggestions tailored to user interests and connections. Netflix is renowned for its movie recommendation engine, delivering personalized viewing suggestions. Similarly, platforms like Yahoo News

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and Google News are well-known for curating news content based on users' preferences. Recommender systems play a crucial role in enhancing user experience by offering relevant content across various domains.

2. Collaborative Filtering

Collaborative filtering is a technique to collect and analyze a large amount of information about user's activities or preferences and predicting what users will prefer based on their similarity to other users. The intension behind Collaborative filtering is that people who agreed in the past will agree in the future, and that they will like similar kinds of items as they liked in the past. The recommender system compares the data of different users and calculates a list of recommended items or user. One examples of collaborative filtering is item-to-item collaborative filtering people who buy x then they will also buy y. Facebook, MySpace, LinkedIn, and other social networks use collaborative filtering to recommend new friends and groups by examining the network of connections between a user and their friends.

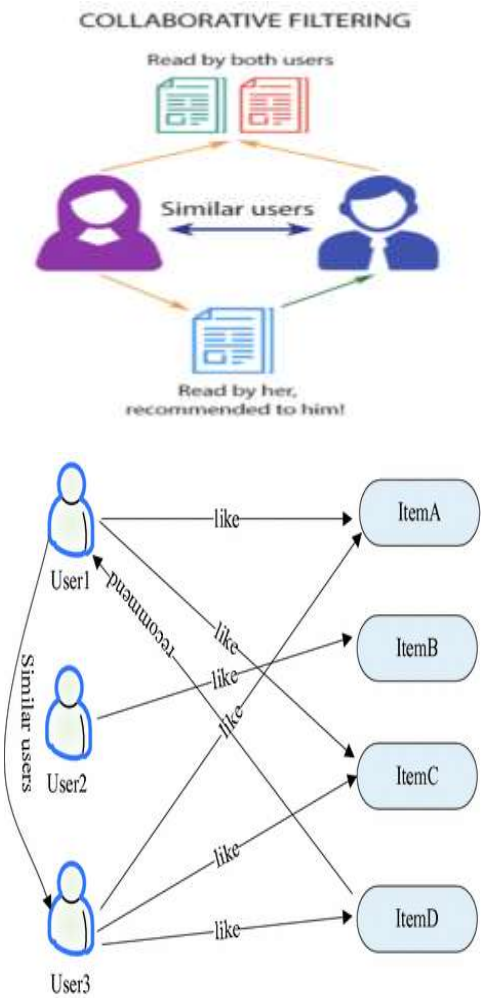

Figure 2: Collaborative Filtering

Two of the main collaborative filtering types are user based & friend-based collaborative filtering approaches. We will talk of User based collaborative filtering only. User-based collaborative filtering takes the users with similar choice or score. The main task of this algorithm is to find the best user set for the chosen user to suggest new friends with the greatest similarities with the chosen user [7].

To find the similarity or degree of correlation between users. a weighted average of the recommendations of several users can be found. The weight age to user's choice would be found by degree of correlation between the two users. The most common measure of correlation is the Pearson Product it is designated by the letter "r" and is sometimes called "Pearson's r". It reflects the degree of linear relationship between two variables and ranges from +1 to -1. A correlation value of +1 means that it is a perfect positive relation among users.

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

II. LITERATURE SURVEY

A new friend recommendation model (FE-ELM), is proposed where friend recommendation is regarded as a binary classification problem. In this model first feature extraction is done by using different strategies and then in training process ELM is selected as classifier to learn the the spatial-temporal feature, social feature, and textual feature, finally experiments are performed on real datasets for better efficiency and accuracy [2].

Authors after evaluating and comparing of five types of recommenders: a people-based recommender, a tags-based recommender, two types of a hybrid recommender (PTBR): a combination of people or tags (or-PTBR) and a (and-PTBR, suggesting only items related to both people and tag and a popularity-based recommender (POPBR). found that combining both related tags and people in the user profile does not significantly increase the interest in recommended items over a pure tag-based approach but it also lowers the percentage of already known items, increases the diversity of item types [3].

The new properties and challenges that location brings to recommender systems for LBSNs are discussed in this paper. First, author has categorized the recommender systems by the objective of the recommendation, which include locations, users, activities, or social media. Second, they categorize the by the methodologies employed, including content-based, link analysis-based, and collaborative filtering. Third, categorize

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the systems by the data sources used, including user profiles, user online histories, and user location histories. For each category, the goals and contributions of each system are summarised and highlights the representative research effort. It introduces the concepts, unique properties, challenges, evaluation methods and future work for recommender systems in LBSNs [4].

Hierarchical-graph-based similarity measurement (HGSM) framework is proposed here, which models people's location histories and determines the similarity between users. In this framework, 3 factors sequence property of users' movements, Hierarchy property of geographic spaces, Popularity of different locations are considered. Using HGSM to estimate the similarity between users, a collaborative filtering-based method is also employed in our system to find an individual's interest in unvisited geospatial regions [5].

A friend recommendation algorithm is proposed which is known as Random walk-based context-aware friend recommendation algorithm (RWCFR). This model uses an undirected un-weighted graph that represents users, locations, and their relationships. RWCFR constructs a sub-graph according to the current context of the user. Local experts and popular locations in region are added to this sub- graph. After constructing the sub-graph, this sub-graph is given as input to our random walk algorithm, and it calculates the recommendation probabilities of users for friend recommendation. A list of potential friends is provided to user according to output of the random walk algorithm [6].

Recommendation system make use of user profile, item description and past behaviour for recommendation but no emphasis has been given on personalisation based explicitly on social networks. This paper uses dataset from the last.fm social network that describes a social graph among users, tracks and tags, effectively including bonds of friendship and collaborative annotation. Experiments are performed between the Random Walk with Restarts model and a user-based collaborative filtering method using the Pearson Correlation similarity on this dataset. The results show that the graph model system benefits from the additional information embedded in social knowledge [7].

The paper analyzes the main challenges of the collaborative filtering algorithm and provides several solutions. To solve cold start problem for the new user, we could replenish user's profile in different ways, the general approach is to require user provide their profile while login the social account and for the new item, we could combine the collaborative filtering and content-based recommender algorithm. There are few solutions for the sparsity problem. The first one uses filling or decreasing the dimension to decrease the sparsity of the matrix. Another solution improves the efficiency of the algorithms without changing the sparsity of the matrix. [8].

Author through analysis on a dataset collected from Foursquare, observe that there exist strong social and geo-spatial ties among users and their favourite locations in the system. So, a friend-based collaborative filtering approach is developed for location recommendation based on ratings of places. Additionally, Geo-Measured FCF (GM-FCF) based on heuristics derived from observed geospatial characteristics in the Foursquare dataset. Evaluation is done to validate proposal and make comparison between the collaborative filtering (CF), social collaborative filtering (SCF) and random walk and restart (RWR) [9].

Temporal, spatial and social correlation are three main attributes of any LBSN. However, the situation which include these three features cannot be solved in previous algorithms. There is no method which utilizes all information properly A new approach of friend recommendation is proposed, which aims to recommend friends with similar location preference for LBSN's users. This approach first, use the method of local random walk based on Markov chain to calculate the user's friendship similarity on social network. Second, it calculates the user's location preference similarity in the real world based on check-in data and finally recommend friends to users by building a mixed user preferences model [10].

LBSN is a new social networking platform for making friends, sharing information, searching contents with the location enabled data but it has increased concern for privacy protection, friend recommendation etc. In this paper SVM based approach for friendship prediction on LBSN is proposed in this model user social relations, check-in distance and check-in type are extracted, information gain is calculated and prediction model is established [11].

Author propose a deep pairwise learning model, namely FDPL. Our model first learns the low dimensional latent embeddings of users' social relationships by jointly factorizing them with the available contextual information based on a multi-view learning strategy. In addition, to account for the fact that the contextual information is non-linearly correlated with users' social relationships we design a deep pairwise learning architecture based on a Bayesian personalized ranking strategy. We learn the non-linear deep representations of the computed low dimensional latent embeddings by formulating the top-k friend recommendation task at locationbased social networks as a ranking task in our deep pairwise learning strategy. Our experiments on three real world locationbased social networks from Brightkite, Gowalla and Foursquare show that the proposed FDPL model significantly outperforms other state-of-the-art methods. Finally, we evaluate the impact of contextual information on our model and we experimentally show that it is a key factor to boost the friend recommendation accuracy at location-based social networks [12].

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Author propose a Friend Recommendation system for social networks which will be measure the frequency of user activities and update the dataset according to the frequency and intensity of their activities. We will be using the K-Nearest Neighbor algorithm; we can easily classify the user activity and behaviors with some criteria. We also build a user's daily life journal, from which their life preferences are extracted by using the K-Nearest Neighbors with threshold algorithm. We use a similar method to calculate the similarity of life styles or preference between users, and determine users' impact in terms of interests with a public-private graph. We have implemented the Friend Recommendation system, and evaluated its performance on both small-scale experiments and large-scale simulations. The results show that the recommendations reflect the users 'preferences in choosing friends [13].

Recent advancements in friend recommendation systems have focused on improving accuracy and relevancy by leveraging various approaches in social media. Kung et al. (2024) introduced an embedding-based retrieval method using Approximate Nearest Neighbor (ANN) query expansion to enhance friend recommendations through refined data retrieval strategies [14]. Similarly, Su (2024) explored product recommendations within social circles, addressing challenges related to inadequate labeling and the social context of user networks [15]. Ding et al. (2024) proposed a meta-path-aware dynamic graph learning model to integrate user mobility, enriching friend suggestions by analyzing temporal connections in dynamic networks [16]. Ramakrishna et al. (2023) introduced HCoF, a hybrid collaborative filtering technique that combines social and semantic elements to boost recommendation accuracy [17]. Furthermore, Alshammari and Alshammari (2023) implemented a collaborative filtering engine specifically tailored for Facebook, demonstrating how personalized recommendations can be fine-tuned within established social networks. These studies illustrate the potential of combining multiple data sources and advanced modeling techniques to refine friend recommendation systems in social media [18].

Problem Statement: The existing system of recommendation used by social media websites are inefficient as they make use of content-based filtering and even if they use collaborative approach the scope is limited because they are based on friend of friend's concept. Many users do not find recommendation made by existing system helpful as they do not know a person or they might not have similar interest, it leads to less interaction over social network among different users which is not beneficial for social network websites as user do not spend much time on site. If user do not find new people and spend less time on social network platform then it is a sign of worry for them therefore, we need to recommend new people to users for similar interest.

III. RESEARCH GAPS

- A location shared by two users could be evidence of similarity or it could also indicate location is popular so more attributes need to taken into account before generating recommendation to find proper connection between users.
- Most LBSN recommendation system suggest locations to user but not friends with similar interest.
- If two users are same in social structure and has overlapped location history there is chance that can become friend.

IV. CONCLUSION

We propose a method for recommending friends on social media platforms based on user's profile data, check in activities, interest etc. A recommender based on comparing one user check in activities, location or interest with other yields better recommendation results that are significantly more relevant to the user than the friend of friend's-based system. The proposed system will increase the scope of recommendation. All social media websites use the recommendation system.

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