Tourism Group Recommender System

Amani Al-Ajlan, Sarah Alabdulwahab, Lulwa Aljeraisy, Asmaa Althakafi, and Rand Alhassoun

Information Technology Department, College of Computer and Information Sciences, King Saud University, Riyadh, Saudi Arabia

Summary
Tourism planning is important for both tourists and citizens. Tourists usually go in groups of either families or friends, and each individual has different preferences. Group recommender systems are useful in this case, which provide recommendations after analyzing the entire group's preferences. Group recommender systems help tourists to decide on a destination, plan their trip better, save time and effort, therefore, solving the choice overload problem. In this study, we develop *Saha*, an Arabic mobile group recommender system, which provides suitable attraction sites according to the individual tourist or a group of tourists' interests and preferences. *Saha* recommends attraction sites, such as historical sites, natural sites, and entertainment sites in various cities of Saudi Arabia based on preferences or interests that the tourists have specified. Additionally, *Saha* allows tourists to review and rate sites and to keep a list of favorite sites. The recommender system uses content-based filtering techniques to generate user-based recommendations. Our goal is to enhance a group of tourists' experiences by suggesting the most suitable attraction sites based on their interests.

Keywords:
Recommender System; Group Recommender System; Content-based Filtering; Mobile Application.

1. Introduction

The importance of tourism came to light from the diverse benefits and advantages it brings to the hosting country. It is a great opportunity for foreigners to discover and learn about any culture, and for the citizens to explore their hometown deeper. Tourism in Saudi Arabia is emerging as it has many wonderful sites and fascinating assets such as museums, parks, historical sites, and UNESCO (The United Nations Educational Scientific and Cultural Organization) recognized heritage sites [1]. Tourism planning in a big country is extremely crucial for both tourists and citizens. Information sources are scattered everywhere whether it is from books, travel experts, friends and relatives' experiences, or social media platforms. Having too many choices leads to a problem called choice overload, where people feel pressured and influenced by a variety of decisions. Due to the growth of the internet along with the information overload problem, the use of recommender systems has started to become necessary.
Recommender system applications have been expanding rapidly and they are present in many aspects of our lives. They can be used to recommend documents, books, movies, television programs, and websites and in various fields such as e-learning, e-commerce, e-library, e-business, and e-government services. Additionally, recommender systems are used in tourism applications to enhance the tourist's experience by finding multiple attraction sites that are specifically suited for each tourist. The advantages of the recommender system can benefit both the users and the companies, it helps users to find the items that they are interested in, and it helps companies to boost their sales and maintain their user satisfaction [2]. Additionally, the recommender system can solve the information overload issue by narrowing the users' options and suggesting the most suitable items to each user, it allows users to discover new items based on their unique preferences, and most importantly it saves time and effort.

There are several types of recommender systems, and the most popular ones are collaborative recommender systems and content-based recommender systems. Collaborative filtering is a commonly used technique in the field of recommender systems. It relies on communities that are similar to the active user and searches for users that share common interests to supply the active user with the best recommendations. Collaborative filtering gathers information about multiple users' preferences, such as the rating history, to determine the level of similarity between the users [3]. The cold start problem is a major challenge in the collaborative filtering approach, that occurs due to the unavailability of data for new items or users [4]. The content-based recommender system recommends products or places to users based on the item metadata and the user profile, which is generated after users provide data about themselves, whether explicitly like ratings or implicitly like opening a link, the data is then used to make suggestions. As the user takes more actions and provides further information the system becomes more accurate [5]. The content-based recommender system goal is to recommend items similar to those that the user liked previously.
In recent years, the research of recommender systems has been expanded rapidly; therefore, many types of recommender systems have appeared. However, many recommender systems can work for only a single user. Various day-to-day activities are crowded by users having different interests, such as visiting a historical place or

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shopping, going to a restaurant or a coffee shop, and whether to watch a movie or a documentary [6]. Therefore, it is important to have group recommender systems (GRS) that consider the suggestions of a group rather than individuals. GRS is used to generate the preferences of the group members by aggregating their interests to make the recommendation result meet the needs of all group members and to have an exhilarating experience. In this paper, we describe the development process of *Saha*, an Arabic mobile group recommender system, which satisfies the needs of Arabic-speaking tourists. *Saha* application highlights the main attractions in Saudi Arabia, such as historical sites, natural sites, and entertainment sites and for each attraction site, *Saha* application provides the necessary information such as entry prices, telephone numbers, opening hours, and locations all in one place. Moreover, *Saha* application enables tourists to exchange experiences by rating and writing reviews for each attraction site. The paper consists of five sections. Section 2 discusses the group recommender systems and previous related works. Section 3 discusses the entire system analysis and its implementations. Section 4 presents the evaluation phase of the system. Finally, Section 5 concludes the paper, along with future directions.

2. Background and Related Works

2.1 Group Recommender Systems

Recommender system methods usually target an individual user; however, many activities are done by groups of people such as traveling, watching a movie, and going to a restaurant [7]. The traditional recommender systems are not suitable when it comes to these types of activities. Therefore, group recommender systems were developed specifically to solve this issue. Several methods have been developed to incorporate every individual's preference, whether they are similar or different, and then recommend items or activities that satisfy the entire group [8]. Group recommender systems face obstacles in finding items or activities that satisfy the group's common preference, which is the foundation of these systems. Thus, various strategies were developed for aggregating individual ratings into a group rating, including average, one user choice, least misery, and most pleasure.

The average aggregation method aims to aggregate the individual preferences by calculating the average of the members' ratings and use this calculated average as the rating for the whole group members. Moreover, a weighted average can be used as a method of aggregation to have the relative importance of each member of the group into consideration [3].

The one user choice aggregation method, also referred to as the most respected person, aims to take the preferences of one user in the group. The scheme is that one member of the group might be the one who decides on what the group is going to choose without referring to the other members of the group [3].

The least misery aggregation method aims to reduce the misery for the members of the group. The scheme is that the group is as happy as its least happy member. Therefore, the goal is to get at least a predefined level of satisfaction for the members of the group. The process is as follows: if the recommendations are aggregated, the group's prediction value for an item is equal to the minimum of the prediction values of all the members of the group for that item [3].

The most pleasure aggregation method aims to maximize the pleasure for one of the group members. This method tries to recommend alternately the items that one group member likes, thereby not considering the preferences of other members. In the case of the aggregating recommendations strategy, the group's prediction value for an item is equal to the maximum of the prediction values of all group members for that item. In the case of the aggregating preferences strategy, the group's rating for an item is the maximum of the members' ratings for that item [3].

2.2 Related Works

Recently, researchers have shown an increased interest in group recommender systems in the tourism domain. For example, McCarthy et al. [9] proposed a travel system called Collaborative Advisory Travel System (CATS) that recommends places to travel for a group of users, the maximum size of a group is four. The system used a collaborative filtering technique, and the aggregation method for the group preferences is aggregated voting which finds the items that maximize the satisfaction of all members in a group. The system uses the DiamondTouch interactive tabletop that allows a group of users to work together in recommendation sessions.

Salam´o et al. [10] proposed the Consensus Negotiation (ConNeg) system, which is an extension of the CATS system. Salam´o et al. [10] added consensus negotiation strategies to the CATS system to solve the user preference conflict problem. Salam´o et al. [10] evaluated different aggregation methods which are the least misery, aggregated voting, most pleasure, multiplicative, and borda count, and showed that the performance of the system was different using different strategies.

Garcia et al. [11] proposed a system that recommends tourist places to groups, and individuals based on their demographic classification and their past trip history. Garcia et al. [11] evaluated different aggregation and intersection strategies and showed that the intersection method obtains better results.

Nozari and Koohi [8] developed a group recommender system and they focus on the group creation step and the

influence of members and the leader on groups. Nozari and Koohi [8] proposed a new method to computes members' influence on each other based on similarity and trust. Additionally, Nozari and Koohi [8] used fuzzy clustering and Pearson Correlation Coefficient similarity measure to create groups. The results showed the importance of considering members' influence and the leader's impact to improve the performance of the group recommender system. Nguyen and Ricci [12] developed a mobile tourism group recommender system that uses a chat-based interface to support group decision-making. Nguyen and Ricci [12] used a user study to study the usability of the system and the quality of the recommendation. The results showed that the system is usable and provides high-quality recommendations.

2.3 Related Applications

There are various applications in the tourism field; the following are some of them:

Visit Saudi [13] is an application that is dedicated to tourism in Saudi Arabia, developed by the Saudi Ministry of Tourism. The application suggests places to eat, events, festivals, trending places, and it mostly focuses on full packages for a specified region. The duration of the packages differs; some are a day-long or more. Visit Saudi can be used by any tourist that wants to explore Saudi Arabia.

Sawah [14] is an application that helps users to explore various cities around the world, developed by Sawah IT. Sawah provides attractions such as restaurants, cafés, entertainment, and shopping locations of the city that the user chooses, including the cities of Saudi Arabia, Africa, Asia, Australia, Europe, the USA, and Canada.

Google Travel [15] is a trip planner website that provides the most popular destinations around the world and gives users the option to search for trips, flights, hotels, things to do, vacation rentals, packages, transportation, and travel advice. Google Travel aims to provide its users with the best possible suggestion based on their preferences along with the duration of the trip.

TripAdvisor [16] is an online travel company that provides online reservations for hotels, transportation, experiences, lodging, as well as restaurants. Travelers across the world can use the website or the application to browse millions of reviews, opinions, accommodations, experiences, restaurants, cruises, and airlines. TripAdvisor, the travel guide, is available in 49 markets and 28 languages with access to over 830 million reviews and opinions on flights, hotels, things to do, and restaurants.

Wafy [17] is a tourist application that is dedicated to tourism in Saudi Arabia, developed by Wafy Networks for Information Technology. It supports Arabic and English languages. Wafy provides both attraction sites and events. Additionally, Wafy contains information about places such as pictures, working hours, and contact information. Wafy has multiple attractions such as shopping, education, entertainment, and historical places.

Foursquare City Guide [18], commonly known as Foursquare or 4SQ, is a platform developed by Foursquare Labs Inc. dedicated to helping people discover the world around them by providing personalized recommendations for its users based on their location, history of ratings, search, or browsing history as well as based on the place's popularity and score. Nowadays, the application contains over 75 million reviews [18].

Culture Trip [19] is a company operating globally in travel and entertainment and providing approximately 450 destinations in various cities around the world. It is available online and as an application, so it can be used by as many people as possible because Culture Trip's goal is to inspire people to go beyond their cultural boundaries.

Meshena [20] is a mobile application that guides people by providing a detailed and organized list of restaurants, cafes, children zones, businesses, and tourist attractions. Meshena allows users to share their photos that are taken during the visit to enhance other users' experiences. It supports two languages, Arabic and English. Moreover, the application provides various areas that tourists might not discover or notice during their stay.

Tours & Travel [21] is a tourist application, developed by eTips LTD, specializing in attraction sites in various countries. It displays plenty of information about cities such as history, culture, shopping, restaurants, activities, and tours. Tours & Travel provides tours in each city with different attractions, durations, and the number of participants.

The comparison table, Table 1, consists of features that are provided by applications previously reviewed. It is clear that none of these applications provide group recommender systems, except *Saha*, yet a majority of the applications provide recommender systems for a single user. In addition, nearby locations, customizable lists, writing reviews, and rating sites are features provided by the majority of the applications, along with viewing the reviews and ratings of other users on each site. Another feature is offline access, which seemed to be a unique feature among the applications because only some of them provide it. Moreover, most of the applications provide in-app booking and half provide search filters. Additionally, most of the applications offer an Arabic interface, some only provide the name of an attraction site in multiple languages, but not the entire interface. *Saha* will address the lack in the market by building an Arabic group recommender system.

Table 1: Comparison Between *Saha* and the Related Applications

Features/Applications	Visit Saudi	Sawah	Google Travel	TripAdvisor	Wafy	Foursquare	Culture Trip	Meshena	Tours & Travel	*Saha*
Group Recommender										✓
Traditional (Individual) recommender	✓	✓	✓	✓		✓	✓		✓	✓
Reviews		✓	✓	✓	✓	✓	✓	✓	✓	✓
Ratings		✓	✓	✓	✓	✓	✓	✓	✓	✓
Nearby locations		✓	✓	✓	✓	✓	✓	✓	✓	✓
Customizable list	✓	✓	✓	✓	✓	✓	✓		✓	✓
Offline access	✓		✓				✓			
Reservations and booking	✓	✓	✓	✓		✓	✓		✓	
Filters		✓		✓	✓	✓	✓			✓
Supports Arabic	✓	✓	✓	✓	✓			✓		✓

3. System Analysis and Implementation

3.1 System Overview

Our system *Saha* is an Arabic group recommender system that recommends attraction sites, such as historical sites, natural sites, entertainment sites, and shopping malls in various cities of Saudi Arabia based on preferences that the tourists have specified. We collect the attraction sites of various cities of Saudi Arabia from Google Places API. Then, we label each attraction site by adding weights for the four specified categories: natural, historical, entertainment, and shopping.

The group recommendation process, as shown in Fig. 1, starts by taking the group members' preferences, which are the weights for four broad categories: natural, historical, entertainment, and shopping. After that, the weights of each member will be aggregated using the average method, therefore, producing the group's weights. Then, the recommender system will perform the cosine similarity calculation on two vectors, one being the group's aggregated weight, and the other is the labels assigned for each site. Finally, *Saha* will recommend the attraction sites by listing them in the order of the most to least similar based on the cosine similarity. The system provides optional registration; however, registered tourists will benefit from additional features, they will be able to add their favorite attraction sites to a favorites list, rate and write reviews about each attraction site that they have visited, giving them a free space to express their opinion.

3.2 System Architecture

Saha system architecture is the Model–View–Controller (MVC) architecture which separates the application into three main logical components: the model, the view, and the controller [22]. As shown in Fig. 2, the view of *Saha* is represented by a GUI where the tourist can create a group, search for attraction sites with filtration, rate, review, add sites to the favorites list, view nearby sites, and interacts with the GUI by entering his/her preferences or the group's preferences to have a list of recommended attraction sites based on the group's weights generated by the controller, which consists of the recommender system. Lastly, the controller will retrieve the data from the model that contains the *Saha* database to display the attraction sites to the tourist.

3.3 System Analysis and Design

The main goal of the system analysis and design is to understand and determine the software requirements. A survey is a well-known requirement gathering technique. Therefore, we conducted a survey that received 633 responses to understand the user requirements. The results of the survey indicated that more than half of the participants face some difficulties when choosing an attraction site to visit. Moreover, approximately 93% of the participants prefer to visit attraction sites with a group of family or friends, about 60% of the groups are made of 2 to 5 members and the majority find it difficult to choose an attraction site that is suitable for all group members. Additionally, 69% of the participants prefer knowing about

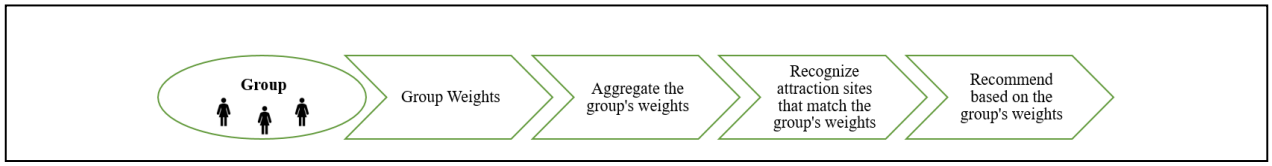

Fig. 1. Group Recommendation Process

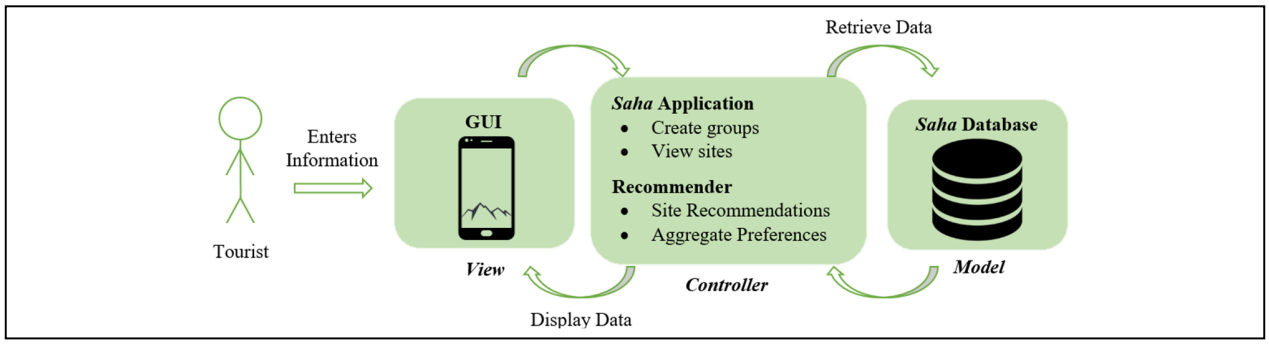

Fig. 2. Saha's MVC Architecture

sites that are either nearby or highly rated by previous visitors. Furthermore, approximately 95% of the participants prefer to save information about the attraction sites that they plan to visit, which is why *Saha* includes a favorites list. Finally, 50% of the participants have used Arabic applications to discover Saudi Arabian attraction sites.

We use an object-oriented analysis and design (OOAD) approach for analyzing and designing our application. Use cases are the common models used in OOAD. Use cases are used to gather the requirements of a system, specify the actors and the relationships between the actors and the use cases. Additionally, use cases are used to determine the system scope and to model the behavior of the system. Fig. 3 presents *Saha* use case diagram that shows the main functions of *Saha* application that are performed by the guest tourist and registered tourist. The following are the descriptions of each use case:

Register: Create an account for the tourist, so he can access additional features.
Search: Search for attraction sites by name.
Filter: Narrow down the list of sites by applying filters.
View nearby site: View the list of nearby attraction sites, based on the tourist's current location.
View site information: View information for attraction site including name, description, location, image, and opening hours.
View recommended sites: View the sites that have recommended to the tourist based on his preferences.
Sign in: Sign into the system and access the account.
View profile: View user profile.
Create group: Create a group of users.
Add user to group: Add members to the group.
Remove members: Remove a member from the group.
Leave group: Leave a group.
Add site to favorites list: Add attraction sites to the favorites list.
Rate site: Rate a selected attraction site.
Review site: Write a review about a selected attraction site.

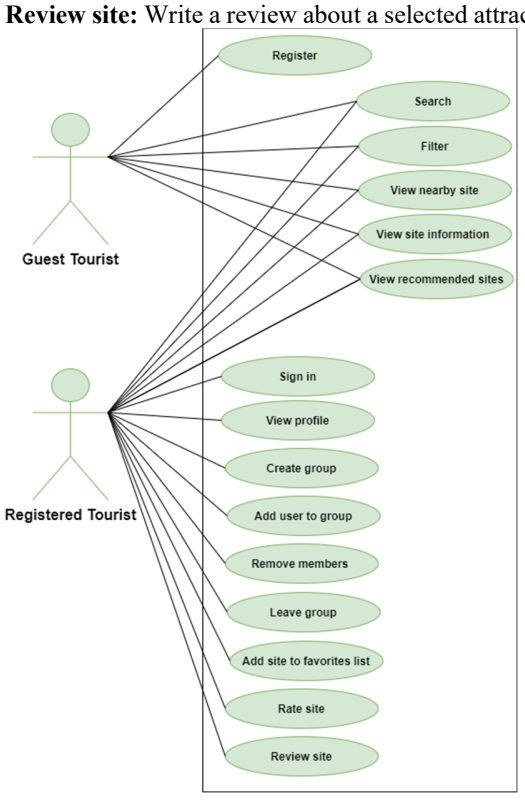

Fig. 3. Use Case Diagram

3.4 System Implementation and Integration

Various software platforms, hardware, and tools were used during the development of *Saha*:
Android Studio. The official Integrated Development Environment (IDE) for Android app development.
Firebase Real-time Database. A cloud-hosted NoSQL database that stores and syncs data between users in real-time.
Firebase Cloud Storage. Cloud storage allows uploading and sharing user-generated content, such as images and videos.
Firebase Authentication. Backend services and ready-made UI libraries to authenticate users to an app.
Google's Places API. A service that returns information about places using HTTP requests. Places are defined within this API as establishments, geographic locations, or prominent points of interest.
Jupyter Notebook. An interactive data science environment.
Android Mobile Device. A Samsung smartphone.

In the system integration, we link the different system components to ensure that all components are interacting correctly and performing their needed functionalities. Fig. 4 is a visual representation of the order of each stage of the system integration process.

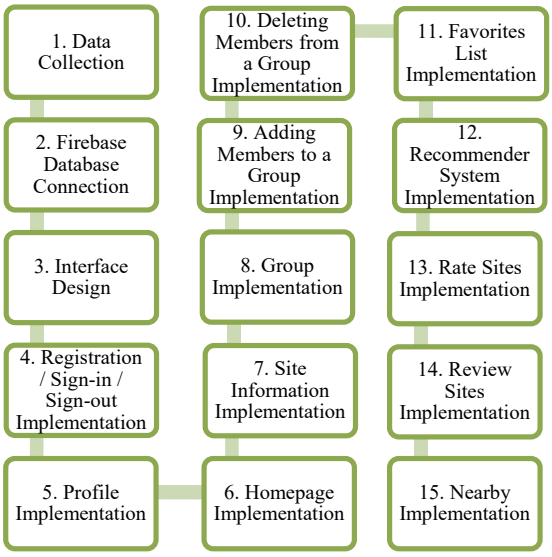

Fig. 5. System Integration Process

3.5 Application Layout and User Interface

A user navigation hierarchy diagram of *Saha* is shown in Fig. 5. It displays the interfaces that the tourist can view and how they are connected. The homepage, groups, nearby, favorites list, and profile interfaces can reach one another due to the navigation bar that is in each of the interfaces. For example, when the tourist is on the profile page, he/she can go to the homepage, nearby sites, favorites list, and groups interfaces, and vice versa. Furthermore, site information can be accessed through four interfaces: homepage, nearby, favorite list, and group information.
The interfaces of *Saha* are designed in Arabic, and we consider the usability standards in designing the interfaces. Fig. 6. shows the interfaces of *Saha* application.

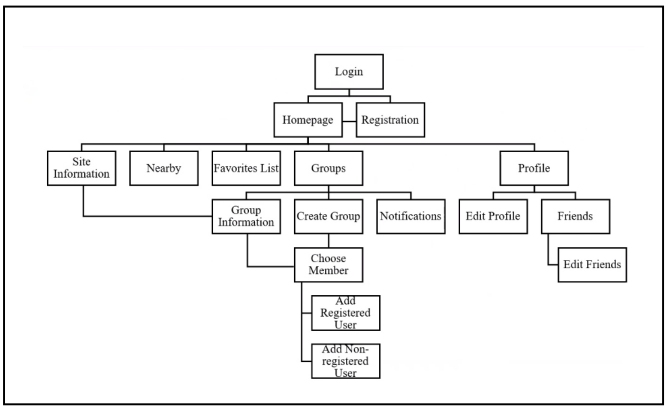

Fig. 4. Saha's Navigation Hierarchy

4. Evaluation and Testing

We test *Saha* system components to ensure the system reliability and robustness using several types of testing methods including, unit testing, integration testing, and user acceptance testing.

4.1 Unit Test

We perform the unit testing method in all *Saha* system components by testing each of them separately to guarantee they work correctly. Table 2 presents the unit testing.

4.2 Integration Testing

We combine individual software modules and test them as a group. We then verify that any recent code changes have not destroyed or altered the already existing functionality of our system. Integration testing is performed to evaluate the compliance of a component or a system with particular functional requirements.

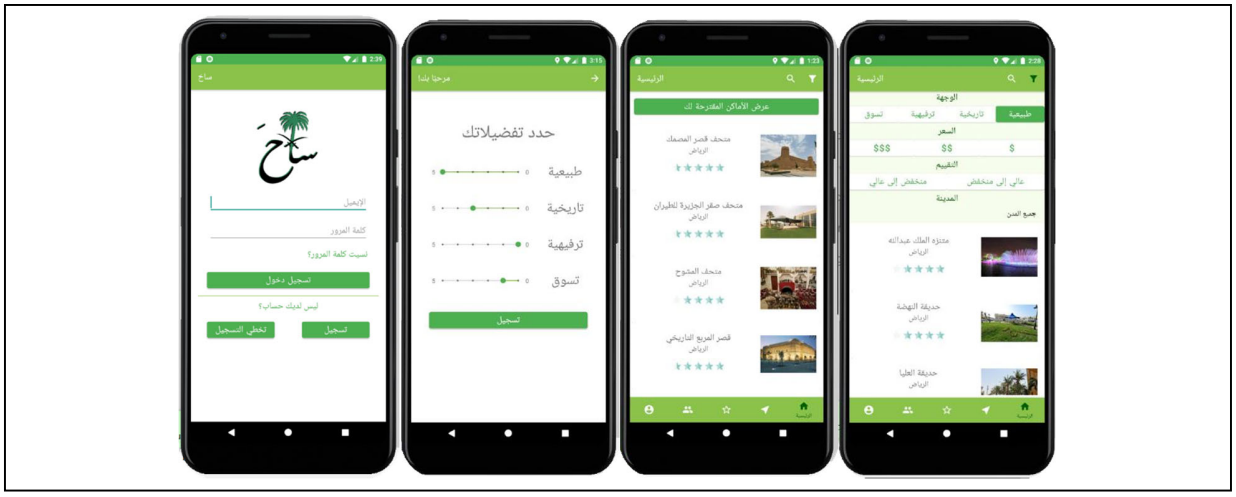

Fig. 7. Snapshots of the primary interfaces of Saha: (a) Sign-in; (b) Specify preferences for four categories: natural, historical, entertainment, shopping; (c) Home page; (d) Filter result options for attraction sites

Table 2: Unit Testing

User	Component name	Component Description	Result
All Users	Component A	Register	Pass
	Component B	Filter	Pass
	Component C	View nearby sites	Pass
	Component D	View recommended sites	Pass
Registered Tourist	Component E	Sign in	Pass
	Component F	Create group	Pass
	Component G	Add registered user to a group	Pass
	Component H	Add non-registered user to a group	Pass
	Component I	Add sites to favorites list	Pass
	Component J	Rate site	Pass
	Component K	Review site	Pass

4.3 User Acceptance Testing (UAT)

A total of 10 users participated in the UAT, in which some of whom were android users, and some were not. The users explore *Saha's* features without any specific instructions. During that time, we observed their actions and behaviors to ensure the usability of the application. Finally, some changes were made based on the observations and feedback, which included changes to the interface and adding some clarifications during the adding member to a group process.

5. Conclusion and Future Work

In conclusion, recommender systems are a collection of algorithms that aim to provide accurate and relevant data for users based on their interests. By using recommender systems in tourism, tourists will be able to look for their favorite destinations and fulfill their preferences. The recommender system in *Saha* recommends attraction sites such as historical, natural, entertainment, and shopping in various cities of Saudi Arabia. *Saha* is an Arabic application that contains a group recommender system since some groups face difficulties in finding suitable sites that satisfy all group members. We are hoping that our system will achieve its goals and objectives and help anyone who is interested in developing group recommender systems and facilitates future research direction.

For future enhancements, we are looking forward to expanding the scope of our application by adding more regions and attraction sites. We aim to add more features and functionalities for instance the ability to add more members to the group, allowing tourists to share photos taken during their stay, and enhancing the quality of the recommendation system by introducing a collaborative filter rather than content-based filtering so we can have a hybrid recommendation system. At this moment, we serve Android phone users, and we would like to expand the database of our users by developing an IOS application. Besides, we are now mostly targeting people who can understand the Arabic language, but we would like our application to support different languages.

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Amani Al-Ajlan is an assistant professor of Computer Science at King Saud University. She received her PhD from the College of Computer and Information Sciences at King Saud University. Her research interests include data science, machine learning, and bioinformatics.