

User Preferences- based Recommendation Algorithm

Case Study: Hajj and Umrah Agencies

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خوارزمية التوصية المستندة الى تفضيلات المستخدم دراسة حالة: حملات الحج والعمرة

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ملخص البحث (Abstract):

تفضيلات المستخدم لها دور مهم في العديد من المجالات مثل الإعلان والتجارة الإلكترونية والرأي الاجتماعي ومحركات البحث. في نظم التوصية ، تفضيلات المستخدم تؤثر بشكل مباشر على دقة التوصية التي تظهر للمستخدم بناء على رغباته. في هذا البحث ، نركز على كيفية تحسين نتائج التوصيات الخاصة ببحث تفضيلات المستخدم على مجموعة من بيانات التصنيف. في هذا البحث تم شرح استراتيجيات مختلفة من خوارزمية الترشيح على أساس تفضيلات المستخدم وإظهار دراستهم بالتفصيل . كما تم اقتراح دراسة حالة تتعلق بجهة الحج والعمرة. ويهدف إلى إنشاء تطبيق للأجهزة المحمولة من نوع أندرويد والذي يساعد الأشخاص في العثور على أفضل حملات الحج والعمرة في مدينتهم التي تلي احتياجات المستخدمين. يعرض التطبيق هذه الشركات وفقاً لموقعها ويمنح خياراً لتحسين نتائج البحث استناداً إلى ملف تعريف المستخدم والتفضيلات التي حددها المستخدمون في شاشة البحث.

User preferences have an important role in many fields such as advertisement, E-commerce, social opinion, and search engines. Mainly in recommender systems, user preferences directly influence the accuracy of the recommendation. In this research we focus on how to improve the recommendation results of user preferences-based search (PBS) on a set of rating data. We explained different strategies of filtering algorithm based on the user preferences and show their studies in details. A practical case study related to Hajj and Umrah agency is proposed. It aims to create an android mobile application that helps people in finding the best Hajj and Umrah company in their city that accommodate user's need. The application shows these companies according to their location and gives an option to optimize the search results based on the user profile and preferences that are selected by the users in the search screen.

Introduction

A preferences-based search (PBS) is a process that helps users to find and identify the preferred options and selections based on user's preferences list and criteria. This process is an interactive tool since user can change his/her criteria list if the search results do not lead user's satisfactions. Usually, users on mobile applications or web pages search through a huge database by entering and identifying their preferences list, which are directly mapped to a database query to retrieve a ranked list of the most appropriate options (Hill, Wesson, 2008), (Junker, 2002). PBS helps users in different

situations such as, finding the best apartments based on user's requirements to live in, selecting the best destination and trip deal that satisfy tourist budgets and activities, or buying a special electronic device that fit user's needs.

Different keys should be considered while designing and implementing one of the PBS tools (Viappiani, Faltings, 2006). The tool should be designed in easy interface that helps user to select their criteria and retrieve the satisfy solution in easy way. In addition, the algorithms that are used in the tool should be worked perfectly with the large and huge database. The Graphical User Interface (GUI) of the retrieved results should be displayed in a view that is suitable to the results type either on the map view or a list view as an example.

Hajj and Umrah are considered one of the greatest acts of worship in Islam, where Muslims from various parts of the world travel to Mecca to perform the rituals of Hajj and Umrah. There are hundreds of Hajj and Umrah companies spread in all cities of Saudi Arabia provide Hajj and Umrah Services for citizens and residents. These companies differ in terms of the quality of their services or in providing some services that are not available in other agencies such as, special service for the children, exceptional care for the special need people, serving diet meal service, low price packages, or short distance agency's location. User preferences and priorities are different from one person to another, which makes the searching results are different from one user to another to find the suitable agency to the user that fit his/her requirements in finding the Hajj and Umrah Company.

In this paper, a multi-criteria preference-based searching technique is used to retrieve the best Hajj and Umrah agency to the user from the mobile application database based on user's preferences. The paper is organized as follows. In Section II, work is reviewed that is related to the experiments reported here. In Section III, the used method and model is described. Section IV discussed the case study and the prototype of the proposed method. The paper is concluded in Section V and the future work is outlined in this section too.

RELATED WORK

Using a preference based search method is challenging and is a focus point to many researchers that are interesting in helping users to find their required search results from the database as accurate as they can. Researches work hard to improve their applications and webpages through finding the best algorithms that display, suggest, or recommend the best satisfied query results to the users based on their preferences or criteria (Hill, Wesson, 2008), (Lu, Li, Xu, 2015).

There are many studies have been implemented on the preference based search algorithms in different areas such as helping students to find the better apartments (Viappiani, Faltings, 2006), guiding the tourist to select the better trip destination that fit user's needs (Hill, Wesson, 2008), (Kiseleva, Mueller, Bernardi, et al., 2015), (Hill, Wesson, 2010), or finding the interested movie that user preferred (Koutrika, Ioannidis, 2002), (Ujgin, Bentley, 2002).

Viappiani and Faltings (Viappiani, Faltings, 2006) presented Flat Finder, which is one of the preference based search tools. This tool designed for the students in order to get the best accommodation for them based on their requirements and budget. In this paper, authors showed two different examples either optimal candidate or suggestions solutions. The optimal candidate gave the flat list according the sorting of the database items based on the cost and showed the top K

query. The suggestion solution gave the list of the cheapest flat, but it might be far from the university or does not have a privet bathroom as an example.

Hill and Wesson (Hill, Wesson, 2008), (Hill, Wesson, 2010) used the preference based searching technique to display the best point of interest restaurants located in the town to the user based on user's criteria and preferences list such as: the price range and the restaurant category. The method ranked and weighted the candidate set that were selected based on the preferences. After that, the candidate with the highest weight, which presents the most preferred options, will be shown. In this paper, Hill and Wesson explained different types of display methods, compared between them, and focused part of their research on the designing requirements for both input (the requirements and preferences list) or the output (the optimal restaurants list) to be either list or map view. The application that authors presented supports all of the interaction, functional, and visualization requirements.

Kiseleva, Mueller, and Bernardi (Kiseleva, Mueller, Bernardi, et al., 2015) presented a three methods that focused on tourism guide field. Authors worked on the methods that retrieve the best destinations to the user that satisfy his/her activities that users looking for in their trip. In this research, authors compared their results with the baseline, Booking.com, and their research showed that the Naïve Bayes approach gives a significant increase in user engagement.

Ujjin and Bentley (Ujjin, Bentley, 2002) built a recommender system that based on the preference based searching technique to give more accurate results and prediction to the users that he/she likes or dislikes and best recommendations to the users. In the database, movie data is stored for each user, means profile for user j on movie i as an example. The record includes, the rating of the specific movie for specific user, the age of that user, the gender, the occupation, and the movie genre frequencies (occupation and 18 movie genre frequencies: action, adventure, animation, children, comedy, crime, documentary, drama, fantasy, film- noir, horror, musical, mystery, romance, sci-fi, thriller, war, western). After the profile data is created, the recommender system can recommend and select movies for user (A) based on the neighborhood selections that are closed to user (A) profile.

System Model

As a basic model, we use the PBST system proposed in (Hill, Wesson, 2008). This algorithm is able to take into account multiple criteria as a user's preference and find the corresponding results. Moreover, it is provide the range procedure for one of the choosing criteria, which gives an ability to the user to determine a prefer range for any criteria not only one value. We custom this algorithm by allowing a user to determine a rang for more than one criteria.

We consider an environment with multi criteria C and multi users N randomly practice the proposed method. Each user $i \in N$ has its own preferences list $L_i \subseteq C$ over provided criteria. The multi criteria area C contains all provided criteria such as $C = \{c_1, c_2, c_3, \dots, c_m\}$ where m is the maximum number of criteria. The length of preference list L_i is $L_{i, len}$ located within $0 \leq len \leq m$. There are two different kinds of criteria: i) checked criteria, that would have 0 or 1 based on the checked-boxes selected by the user, and ii) range criteria, are a continuous attributes with a maximum max and minimum min limit. Thus, user i submits its preferences list as:

$$L_i = [c_1^i, c_2^i, c_3^i, \dots, c_m^i] \quad (1)$$

The value of criteria j for user i has many possibility, such as:

$$c_j^i = \begin{cases} 0 & \text{if } j \text{ is a checked criteria dose not chosen by } i \\ 1 & \text{if } j \text{ is a checked criteria has been chosen by } i \\ \{min, \dots, max\} & \text{if } j \text{ is a range criteria} \end{cases} \quad (2)$$

The practical steps of the algorithm are discussed in the following subsections:

A. Calculate Total Weight

At the beginning, total weight is initializing to zero. Then one is added to the total weight for each check-box selected, in case of checked criteria type. In case of range criteria, the corresponding value that reflects how many ranges have been selected must be added to the total weight. For example, the range of criteria j has five available ranges, in case user i selects only one range, as result 5 is added to the total weight, thus 5 is the optimum score. In case user i selects two ranges, the optimum score 4 is added to the total weight, and so on. In case no range is selected 1 is added to the total weight.

B. Determent the Score for Range Criteria

For each criteria from type (range criteria), the algorithm generates an array to determine the score for each range. Range criteria RC $_j$ has five ranges= {R,RR,RRR,RRRR,RRRRR}, where min = R and max = RRRRR. Figure 1 shows generated array when user i choose the second and third ranges as preferred reneges. While, figure 2 shows generated array in case the chosen range is first one. The score for each range is determined based on the optimum score, as mentioned in III-A. The optimum score is placed on the selected range(s). Then the score for all surrounding range(s) is determined based on the distance from the selected range(s), such that 1 is decremented for each forward/backward range.

R	RR	RRR	RRRR	RRRRR
3	4	4	3	2

Figure 1. Array generated if RR and RRR are selected

R	RR	RRR	RRRR	RRRRR
5	4	3	2	1

Figure 2. Array generated if R is selected only

C. Allocated Ranking

For each candidate row in the candidate set a score is calculated. At the beginning, the score R_i^S for candidate R_i is initialized to zero. Then 1 is added to R_i^S for each criteria matches the check-box selected. Moreover, a value of rang criteria is added to the R_i^S based on which range the candidate falls into. Finally, the R_i^S is divided by the total weight to get the rank for R_i .

D. Example

Table 1 shows the database of available Hajj and Umrah agencies. The preference list of user i is: $L_i = [1, 0, 0, \{3000-10000\}, \{3-6\}]$. Figure 3 shows the available ranges for price criteria, while Figure 4 shows the available ranges for distance criteria.

Table 1. Hajj and Umrah Agencies

Hajj and Umrah Agencies	Spacial Need	Child Care	Diet	Price	Distance	Quality
1	√	√	×	15000	3km	***
2	√	×	√	10000	3km	***
3	√	×	×	5000	6km	*
4	√	√	√	20000	2km	****
5	×	√	×	3000	7km	*

R	RR	RRR	RRRR	RRRRR
1000 - 3000	4000 - 9000	10000 - 14000	15000 - 190000	20000 - 30000

Figure 3: Price Ranges

D	DD	DDD	DDDD	DDDDD
14-15	11-13	7-10	4-6	1-3

Figure 4. Distance from Jamarat Ranges

The total wight is : $1(\text{spacial need}) + 3(\text{price range R\&RR\&RRR}) + 4(\text{distance range DDDD\&DDDDD}) = 8$. Price and distance arrays are generated as appear in Figure 5 The final score for agencies number 1 is: $1(\text{spacial need}) + 2(\text{price range}) + 4(\text{distance}) = 7$, as a result the ranking is $(7/8)/100 = 70\%$. The ranking for all other agencies respectively are: 100%,100%,60%,60%. Thus, the recommended agencies are agencies number 2 and agencies number 3.

R	RR	RRR	RRRR	RRRRR
3	3	3	2	1

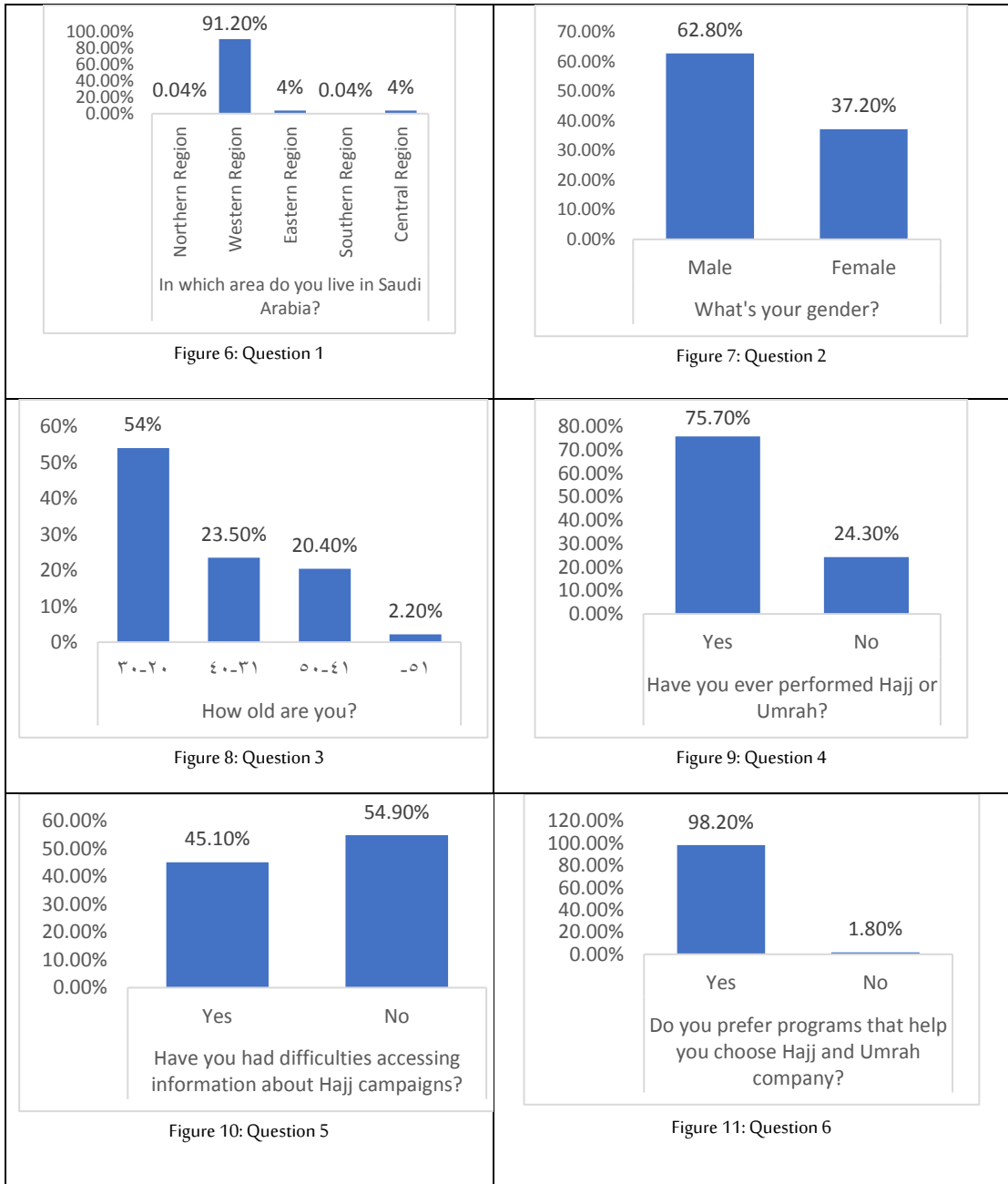
D	DD	DDD	DDDD	DDDDD
1	2	3	4	4

Figure 5. The two generated arrays for the price and distance ranges

Need for an Application

The Ministry of Hajj and Umrah issued an initial license to more than 780 Hajj and Umrah agencies, so they can start their activities (The Middle East Newspaper,2017). This increase in the number of agencies working in the field of Hajj and Umrah aims to increase the level of services provided to pilgrims and to meet the objectives of Saudi Vision 2030 in the Hajj and Umrah sector. These agencies offer different services in terms of transport, hotels, health facilities as well as services related to children. The level of services offered to pilgrims varies based on the total cost of the Hajj or Umrah.

Thus, choose the best agency is difficult because pilgrims need to contact many agencies to inquire about their service and prices. The traditional way of asking about these agencies through mobile or even asking friends leads to the loss of time and effort and lack of access to accurate information. A questionnaire was designed and distributed through Google forms via the Internet and the results were as follows, which are collected from participants.



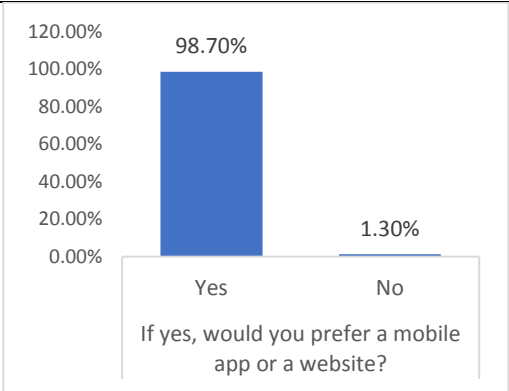


Figure 12: Question 7

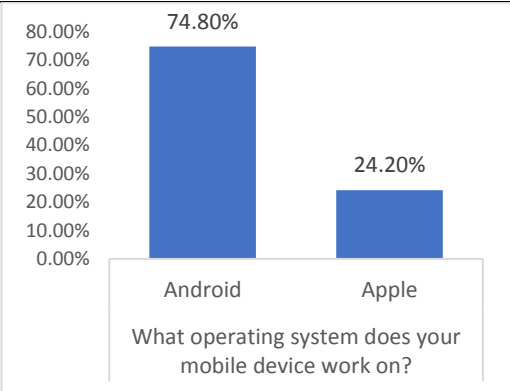


Figure 13: Question 8

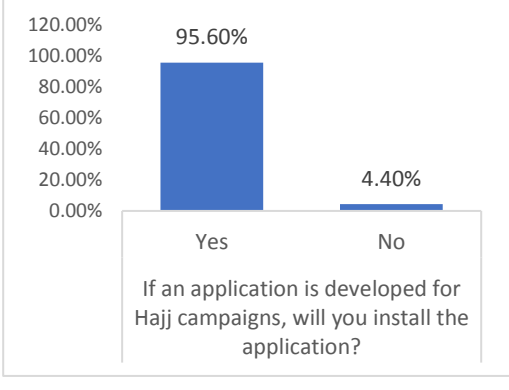


Figure 14: Question 9

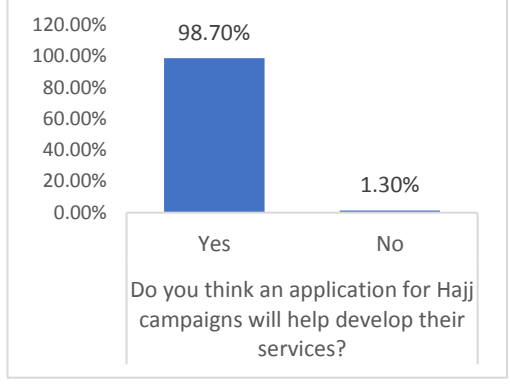


Figure 15: Question 10

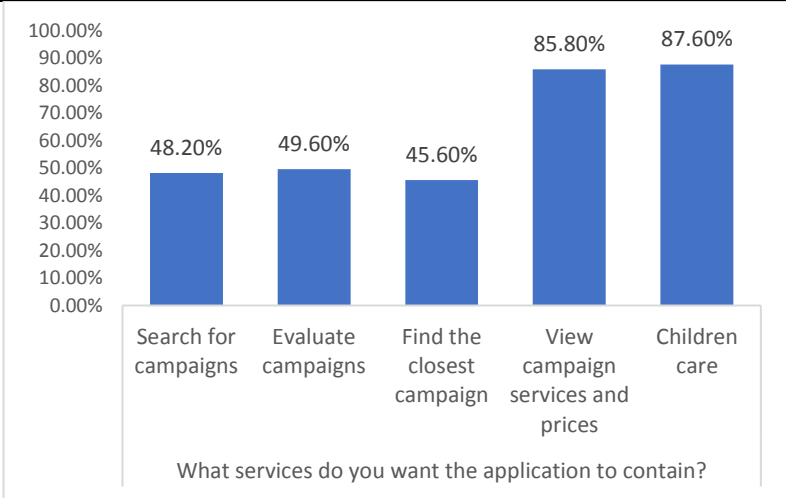


Figure 16: Question 11

Yusur Application

We use the explained algorithm to create a preference-based search application for Umrah and Hajj agencies called Yusur. Figure 17 shows the start screen of the application in a, and the login in b. As appears in a Yusur application supports Arabic and English language.

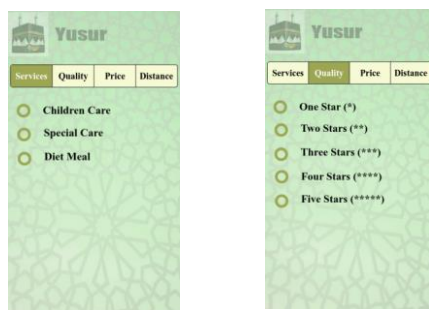


(a) Start Screen

(b) Login Screen

Figure 17. Start and Login Screens

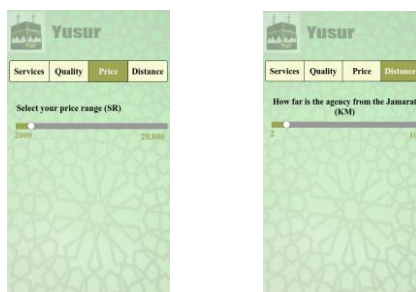
Yusur application provides four main subcategories: services, quality, price, distance, as appears in Figure 18 and Figure 19. Where services includes children care, special care, and diet meal. A user can choose as many as wants from these subcategories, then Yusur uses these chosen subcategories as preference list of the user.



(a) Services

(b) Quality

Figure 18. Subcatogeries (Checkbox Type)



(a) Price

(b) Distance

Figure 19. Subcatogeries (Range Type)

The recommendation of Yusur appears as list as Figure 20. The user can get more information about each agencies by clicking on icon next to agencies name, as Figure 21 Also, a map view is provided as Figure 22, that show the distance of agencies from the main point.

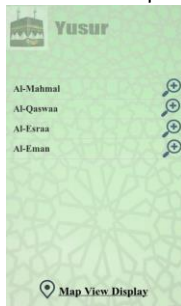


Figure 20. Results in a List view



Figure 21. Results List Details

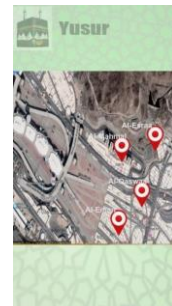


Figure 22. Results in a Map view

Users at the end of the application should give the satisfaction rate of their experience in using YUSUR and show if this application helped them for choosing the best agency that meet their preferences and requirements as shown in Figure23

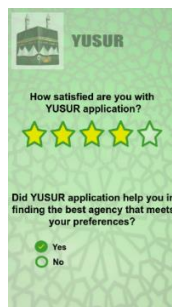


Figure 23. User's Satisfaction

SUMMARY AND CONCLUSION:

In this paper we discussed a preferences-based search algorithm, that generates a ranking result reflects user preferences. Then use this method to purpose the Yusur application. Yusur is a mobile application helps users to find the Hajj and Umrah agencies that satisfied their requirements.

RECOMMENDATIONS:

4. Create a complete database.
5. Adding more features.
6. Displaying the closest important services to the resulted agencies like hospitals as an examaple.

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