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AN INVESTIGATION FOR DEVELOPING LOCATION SENSITIVE MOBILE CITY APPLICATION INTERFACE: A CASE FROM ERZURUM

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Abstract

In this study, a methodology for designing location sensitive interface which is developed for mobile city applications is proposed and a conducted for Erzurum city. In this context, Erzurum city is divided into seven regions (Aziziye, Cadde, Gez Mahallesi, Kayakyolu, Yıldızkent, Yakutiye, Yenişehir) according to the population that higher than 30.000. For each center, participants that are selected by stratified sampling were asked to order the priority of services that they need to. Service options were determined according to the existing mobile application of 12 metropolitan cities including both domestic and European cities. Concerning the findings, participants' patterns of their need orders basis on their location were grouped and main factors were determined. As a result, sample interfaces were designed basis on their choices. These results have a guiding role for future researches and interface development of location sensitive mobile city applications.

Keywords: Mobile City App, Location Sensitive Design, Mobile Interface Design

INTRODUCTION AND LITERATURE REVIEW

As contemporary way to access information, mobile applications are the indispensable technology in many parts of our lives from entertainment to smart cities. These applications offer many services to enable human beings to carry out daily work and professional issues. Although nowadays many successful mobile applications focus on game content, m-commerce application, booking systems, m-learning applications, instant messaging, free call, and other informatory apps have been come in to use. One category of these applications is mobile apps for cities.

Mobile apps for cities offer many information for local people, domestic tourist and foreign tourist to handle their work and jobs easily. To do so, these applications include maps, GPS service, event and news alerts, transportation information, and health information and so on. When someone comes to a city, she/he needs timely information for many purposes. That is to say, since human beings are mobile, we need mobile information for effective and efficient way of access to what we need. However, sometimes we may not able to access the information via mobile apps because of internet connection mostly related technical problem of Internet Service Provider (ISP) and usability problems of the applications.

As mentioned in Cagiltay (2011), human computer interaction (HCI) studies focus on usability problems with four main components: interface, tool, user and task. The usability problems generally occur because of low-level interaction of these components. The main aim of this field is to design effective, efficient and satisfactory user interface. In order to cope with this problem, two approaches had been proposed; i) Suchman (1987) discussed that the systems should be interactive and should understand what the user needs ii) Norman(1988) argue that interfaces should be well designed so that the message from machine/interface is delivered to the user in an effective way. Although Suchman's ideas had been considered extraordinary, nowadays many studies have been conducting to solve HCI problems in order to create intelligent interfaces.

In the study of Hong, Suh and Kim (2009), context-aware systems are summarized and classified. These systems mainly interested in design systems offering 'anytime, anywhere, anyone' services and decrease mental load of users by reduce dependencies to the interfaces. That is; systems are tried to be made adaptive to context to understand the users' intentions. For example, in the study conducted by Lafond, Proulx, Morris, Ross, Bergeron-Guyard, and Ulieru (2014) proposed a system called RECON (The recommending cases based on context) for integrating intelligent virtual analyst capability system (iVAC), which is knowledge system as an interface component, to reduce human-mental overload. They suggest that, alleviating human-cognitive load can be achieved by two ways i) providing a system capable of sensing the user's contextual state using a brain-computer interface, ii) adapting the system to the user's context.

These advances in HCI studies affect designing "e-" and "m-" systems. Although many technological developments emphasize removing platform dependency in web and mobile technologies, interface customization is a contemporary issue. As mentioned in the study of Kappel, Proll, Retschitzegger, and Schwinger (2003), ubiquitous applications should be adaptable to the context to provide easiness to users. More recently, studies like Lan, Jianjun and Qizhi (2013) expressed that personalized customization interface can be conducted by user centered and interaction centered design approach. Customization and personalization of systems can be carried out by many approaches like; user derived interface design (Good, Whiteside, Wixon, and Jones, 1984), experience based adaptive intelligent interface and adaptive interface design (Hancock and Chignell, 1988; Carroll and Aaronson, 1988), adaptive hypermedia (Rutledge, Van Ossenbruggen, Hardman, and Bulterman, 1997), information filtering and recommendation systems (Ricci, Rokach, and Shapira, 2011). With the advances of

ubiquitous and pervasive computing technologies, intelligent interfaces and context-aware systems can be easily operable for mobile apps for cities.

In the related literature, limited researches have been conducted to investigate intelligent and adaptive mobile application interface design for cities. One of the research conducted by Song, Oh and Woo (2014) proposed an activity-centered design method based on neural network methods. The study focused on extraction of user behavior and adapt systems to make user more convenient to find frequently searched apps easily. Böhm and Szwec (2013) propose a user-centered design for energy saving by providing intelligent user interface. Lin, Luo, Lin and Yueh (2015) conducted a study by using content-oriented and operation-oriented techniques to provide interface for elder people during newspaper reading task. AlSuwaidan and Mirza (2014) investigated m-commerce interface based on user preferences. However, there are limited interface design studies on mobile apps for cites.

The aim of this study is to develop a method for interactive interface design, which based on location information for mobile application. In order to collect data, a pilot study were conducted in Erzurum, Turkey. Existing city applications in Turkey and Europe were analyzed to determine most commonly used features of city applications. Then a questionnaire is developed for data collection. Validity of this data collection instrument is provided via expert opinion. Seven central locations in Erzurum were identified for data collection. Questionnaires applied to the randomly selected people in those centers. They were asked to rate information they need. Demographic information and rating results were analyzed with frequency analysis for location based adaptive interface design.

METHODOLOGY

In order to investigate location based interface design, descriptive research design is used in this study. In this type of research, it is aimed to describe the situation based on quantitative data. In this study, participants were asked to rate the information they need. Frequency analysis have been used to propose location sensitive interface.

Subjects

The population of the study is the users that intended to use mobile application for Erzurum. Participants are selected by stratified sampling which enable us to select participants based on selected locations.

Table 1: Demographic Information of Participants

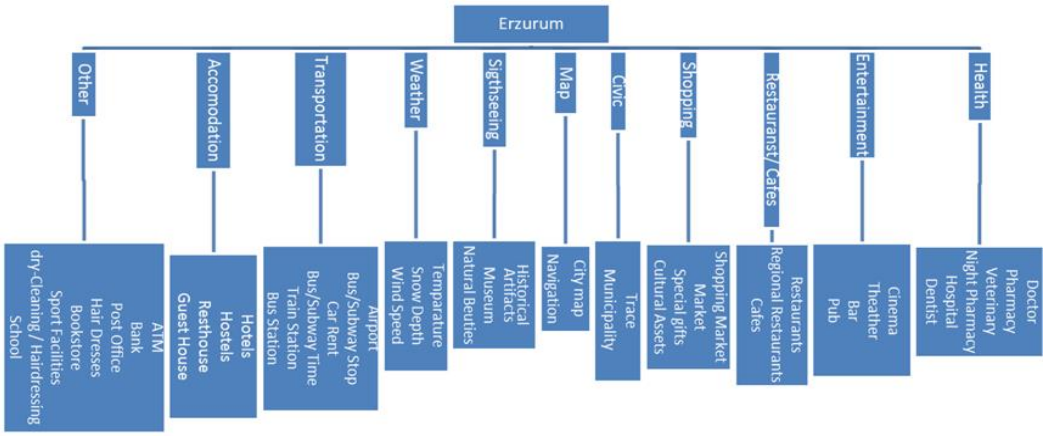
	Gender	**Age**	**Education Level**	**Smart Phone Ownership**	**Total**
Participants	Male: 42 Female:60	Min : 16 Max : 66 Mean : 25 StdDev :8,8	Primary School :6 High School:38 Under-graduate:51 Master :7	Using SP :88 Not Yet :14	102

As it is shown in Table 1, total of 102 subjects, 60 female and 42 male, have participated in this experiment. The participants were between 16 and 66 years of age with 25,4 mean age and standard deviation of 8,8. Of these participants, 6 have primary school degree, 38 are high school graduates, 51 are under-graduate students, and 7 are master alumni. Those of 102 participants, 88 ones are using smart phone.

Instruments and Data Collection

The questionnaire composed of three part was used as a data collection instrument. The first part of the questionnaire consists of demographic information including gender, mobile application experience. If they have smartphone and have experience, additional questions forming second part of the questionnaire. In the second part of the questionnaire, participant's smartphone experience and their mobile city application experience were asked in more detail. In addition, questions about the content and usefulness of mobile applications that they have already used were asked. In the third part of the questionnaire, all participant regardless smartphone experience were asked to sort the possible menu options. The options are determined by using some mobile application for cities including; Ankara, İstanbul, Konya, İzmir, Kocaeli, Denizli, Antalya, Diyarbakır, Munich, London, Prag, Moscow. For this part, questions were determined based on the analysis of 12 different city mobile application interface and components. This analysis enabled us to list commonly used menu options (Figure 1).

Figure 1. Commonly used menu options



FINDINGS

In this part of the study, findings about the second and third part of the questionnaire are presented. They were asked their smartphone brand, operating system, mobile app experience, mobile city app experience and other application related questions.

Table 2. Participants' Mobile Application Experience

	Mobile Phone User	**City - Application User**	**Awareness of m-city application**
Participants	Smart phone User:89 Regular-Cell phone user: 13	User :9 Non-User:80	Aware: 15 Used : 9
Total	**102**	**89**	**24**

First, participants' the smartphone and city application experience is summarized in Table 2. Accordingly, 16 of those use IOS, seven participants use windows mobile and remaining 66 participants preferred to use Android operating system with their smartphone. In total 89 participants have been used smart phone. Only 9 of those have not used any mobile applications. In short, 80 participants have used application with their smartphone. According to the findings, 24 of participants have heard about mobile city application. However, only nine

participants have used at least one mobile city applications including; İstanbul, Ankara, Bursa, Diyarbakir, Antalya, Kırklareli and Cidde. According to those participants, ease of use, visibility, design, traffic information, cafes, recreation sport, design and tourism. While three of mobile city application users complained about the inconsistency, six of those mentioned about the consistency of the application. In terms of usefulness, ease of use, design, speed of use and logical menu design mobile city application users have different ideas.

In the third part of the questionnaire, participants were asked to sort the mobile services they need according to priority. In total 11 services, options were provided to participants (Figure 1). In other words, they should sort the services that they might need to find according to the priority. Findings are stated according to the service preference level. In Table 3, in which services are preferred as a first priority is shown according to the location.

Table 3. Services preferred as the first priority

1.Priority	Transportation	Accommodation	Entertainment
AZİZİYE	1	3	0
CADDE	6	6	2
GEZ.MAH	2	3	6
KAYAKYOLU	1	0	1
YILDIZKENT	11	3	3
YAKUTİYE	2	3	2
YENİŞEHİR	0	1	1
Total	**23**	**19**	**15**

Accordingly, in Aziziye, 1 participants give the highest importance on transportation. However, 11 participants from Yıldızkent consider transportation as the first priority. The priority distribution of the participant is more balanced in Cadde, where is more central location. In total 23 participants pointed out transportation, 19 participants selected accommodation and 15 participants selected entertainments respectively. For the second preferences of the participants according to the location is shown in Table 4.

Table 4. Services preferred as the second priority

2. Priority	City Info	Restaurants/ Cafes	Sightseeing
AZİZİYE	0	1	0
CADDE	0	0	4
GEZ.MAH	3	3	2
KAYAKYOLU	0	0	1
YILDIZKENT	2	0	1
YAKUTİYE	3	2	4
YENİŞEHİR	0	1	3
Total	**8**	**7**	**15**

As shown in Table 4, it can be seen that sightseeing is the most commonly options as second priority of the participants regardless of the location. The case is slightly different for the Cadde location since none of participants rate the city info and Restaurants as the second priority although the location is considered as one of the city meeting point. In terms of third priority, findings are shown in Table 5. In table five, in summary 8 participants rated map option, 5 participants prefer health option as a third priority.

Table 5. Services preferred as the third priority

3. Priority	Health	Map	Weather
AZİZİYE	1	2	0
CADDE	0	2	0
GEZ.MAH	1	0	0
KAYAKYOLU	2	1	0
YILDIZKENT	1	1	0
YAKUTİYE	0	2	1
YENİŞEHİR	0	0	0
Total	**5**	**8**	**1**

Overall findings are shown in Figure 2. The figure is prepared according to color rating techniques that represent the importance of the options based on heat map approach.

Figure 2. Heat map table for preferences (first priority).

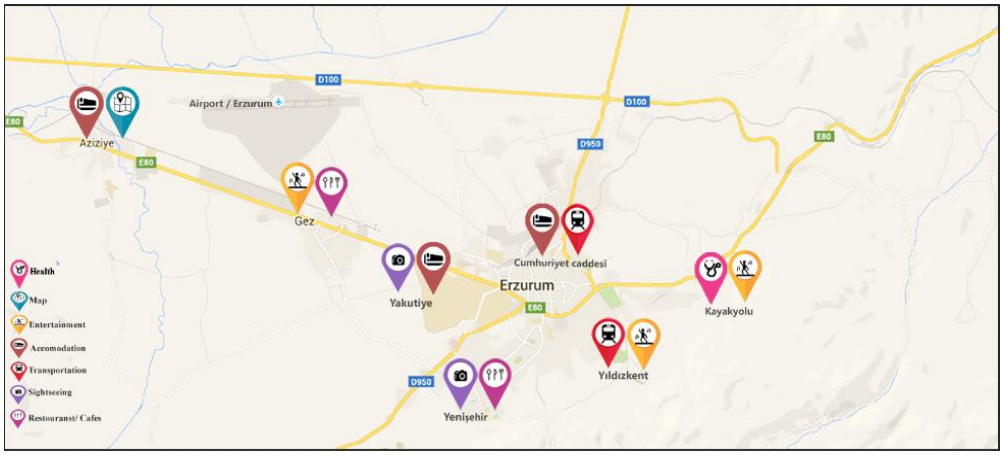
Centers	Transportation	Accomodation	Entertainment	Civic	Restaurants/ Cafes	Sightseeing	Health	Map
AZIZIYE	1	3	0	0	1	0	1	2
CADDE	6	6	2	0	0	4	0	2
GEZ.MAH	2	3	6	3	3	2	1	0
KAYAKYOLU	1	0	1	0	0	1	2	1
YILDIZKENT	11	3	3	2	0	1	1	1
YAKUTIYE	2	3	2	3	2	4	0	2
YENIŞEHIR	0	1	1	0	1	3	0	0
Ortalama	3,285714286	2,714285714	2,142857143	1,142857143	1	2,142857143	0,714285714	1,142857143
Toplam	23	19	15	8	7	15	5	8

According to results of Figure 2, transportation is the most preferred menu option for almost all locations. It can be seen that it is much more important for the participants from Yıldızkent, where is relatively out of city but have higher native population than other locations, and Cadde, where the most crowded place in Erzurum during the day. This is also, why accommodation option is the most preferred option by the participants from Cadde. The participants from Gez location mostly select entertainment option. Health option is mostly selected in Kayakyolu location.

RESULT AND CONCLUSION

In the scope of this study, location sensitive interface design methodology has been proposed. This method is applied for Erzurum city. With this respect, Erzurum city divided into 7 centers and for each centers randomly selected participant asked to rate the information they need from the list determined according to the existing city applications. 102 people participated in the study. According to the results, the mostly preferred two services is shown in Figure 3. The figure also give an idea about the centers and their distance to each other.

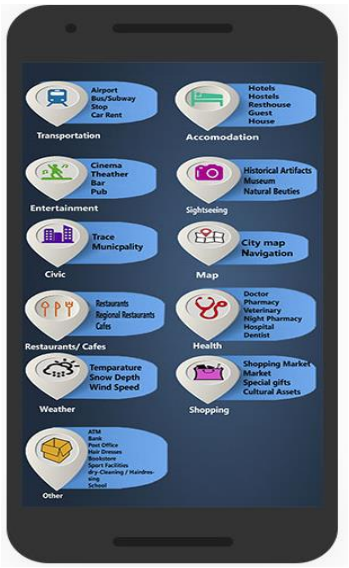
Figure 3. Mostly preferred two services according to locations.



As it is seen that people visiting Aziziye need to know information about accommodation and city map while those of visiting Gez want to know where the restaurants and entertainments are. The top two options for the participants from Cadde are accommodation and transportation. Similarly, civic and accommodation for Yakutiye, civic and restaurants for Yenişehir, transportation and entertainment for Yıldızkent and transportation and entertainment for Kayakyolu are the top two options according to the findings.

When the overall findings are considered to develop a common interface for Erzurum city, it can inferred that transportation, accommodation, entertainment, sightseeing, civic, restaurant/cafes, city map, health, weather, shopping and others (banks, ATMs, Post office, Schools etc.) should be placed respectively to meet the visitors or local people needs in general. A sample design is shown in Figure 4.

Figure 4: Sample general interface design for mobile city application of Erzurum city.



It is important to note that, this design should be adaptive according to the centers mentioned above since the needs are changing with respect locations people live or visit. In addition, the study should be repeated for similar cities to find suitable interface option.

Furthermore, this study has some limitations. For example, number of visitors vary according to the seasons since Erzurum has large ski centers. That is, the preferences may change according to the seasons. In addition, local people and tourist have different priorities. Therefore, this study may also be extended to investigate user type, users' visiting experience and so on. Lastly, context aware systems may also enable us to estimate the need of users according to route or path that she/he traces.

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