International Journal of Public Administration in the Digital Age
Volume 7 • Issue 1 • January-March 2020

Using Hotspot Information to Evaluate Citizen Satisfaction in E-Government: Hotspot Information

Gunay Y. Iskandarli, Institute of Information Technology, Azerbaijan National Academy of Sciences, Baku, Azerbaijan

ABSTRACT

The identification of issues that the public cares about in e-government can help government agencies improve the quality of services and increase citizen satisfaction. In this environment, citizen satisfaction can be provided by finding hotspot services that the public and specific regions are interested in. For this purpose, a method for the detection of hotspot services, citizen satisfaction from these services, and the interests of the regions in e-government has been proposed. In this method, the number of uses from services and the service satisfaction rating has been calculated using the satisfaction score given to them, the system has been evaluated and the fields of the common interests of regions to services have been defined. The method has been evaluated in the practice. In addition, we gave information about citizen satisfaction in e-government environment, and presented a review of the related work.

KEYWORDS

Citizen Satisfaction, E-Government, Hotspot Information

1. INTRODUCTION

Today, the number of forums, blogs, and microblogs is increasing every day. Using these sources, citizens can express their opinions on certain issues. One of such platforms is e-government. E-government is characterized through the integration of e-democracy, services and resources. E-government portal is considered to be one of the most important channels for the provision of public services and government-citizen interactions. This portal contains numerous valuable information resources provided by state agencies. Using these resources, it is possible operatively and in time to determine the main issues in the interest of the society. It can be detected by using the time, the number of requests, and also the comments on a particular service. In literature, the information that people are more interested in is called hotspot information. We should note that the hotspot can be not only information but also certain events, forums, cities, diseases, business, and so on. For example, by detecting hotspots of diseases, we can identify diseases that most people suffer, and by the means of the hotspots of events, the most common occurrences of particular events (fires etc.) and their reasons can be defined. Moreover, there is also the concept of hotspot information as mentioned above, which has gained popularity in recent years (Wang et al., 2015; Li & Wu, 2010).

Detecting hotspot information in online environment has several benefits and they are mentioned as follows (Wang, 2013):

DOI: 10.4018/IJPADA.2020010104

- It can help the user make the right decision about certain commodities and services at any period of time;
- Determining the direction of public interest in society and conducting it to the management in order to assist the related units (organizations/structures) of the Government can provide the Internet users with a "healthy" orientation.

Currently, there exists a number of problems related to the detection of hotspot information. As the number of web pages increases, it becomes difficult to cluster them. This requires extended investigations.

Taking into account the importance of the problem, in the paper, we propose a method to determine the hotspot services and the citizen satisfaction of those services within the e-government. In this method, the number of usages from services and the service satisfaction rating has been calculated using the satisfaction score given to them, the system has been evaluated and the fields of the common interests of regions to services have been defined. The paper is structured as follows. Second 2 includes a review of the related work. Section 3 presents information on providing citizen satisfaction in e-government environment. The proposed method is given in Section 4. Experiment and results are provided in Section 5. Section 6 concludes our paper.

2. RELATED WORK

Today, the Internet has become one of the significant platforms where people receive and share their knowledge. In the meantime, popularity of e-government systems in different areas of administration increases, and therefore, there is an emerging interest in both academia and government sectors to evaluate the different impacts of these systems (Córdoba-Pachón, 2015; Noto, 2015; Anthopoulos & Sirakoulis, 2015). By the use of this environment, it is possible to identify issues that most people are concerned about, their opinions on certain services, hotspot information, and so on. The determination of hotspot information on the Internet is one of the actual problems. A number of studies have been carried out in this direction. Some of these studies have been analyzed below.

The authors of the paper (Ming et al., 2018) successfully applied the D&M information system success model (DeLone & McLean, 2003) to develop an e-service quality model and explored the impact of service quality on citizen satisfaction in China. The research showed that the data adequately fit the measurement model and structural model. Ya (2009) proposed the system for automatic assignment of hotspot events on the Internet for a certain period of time. Thelwall et al. (2011) analyzed Twitter platform and studied the reasons for certain conflicts between the people. Chaovalit and Zhou (2005) showed in their previous work that online reviews provide consumers with important information about the product and they proposed a statistical-based approach. Li and Wu (2010) proposed two machine learning methods, K-means and SVM for prediction of online hotspot forums. In the paper, K-means has been used to obtain a clustering view for all forums within the window of time and forums that are closer to the cluster center have been used as hotspot forums. SVM was used to predict hotspot forums for the current windows of time, using the information from the previous window. Thelwall et al. (2010) offered a semantic approach to predict hotspot forums. In the paper, K-means and SVM classification methods for the clustering analysis of the forums are combined after measuring the emotional polarity of the text. The method to determine city hotspots has been proposed by Qin et al. (2017). In this paper city hotspots have accepted the areas where residents visit frequently, and large traffic flow exist. To determine city hotspots, taxi trajectory data was used, and the data field-based cluster analysis technique was applied. The area with a number of trajectory points is accepted as the hotspot, and the thin trajectory area is defined as the area with a lower potential. The work of Ghahramani and Hon (2018) were conducted to detect the spatial distribution of mobile phones. Here, the distribution was calculated using the Kernel Density method, the neighbor list of spatial objects was created, and various autocorrelation tests have been conducted

to evaluate the spatial dependence related with the variability of interests. Hotspots have also been defined using several features of mobile towers. An approach to detect hotspots using Twitter data has been proposed by Stojanovski et al. (2016). In this paper the advantages and disadvantages of various clustering algorithms (hierarchical agglomerative clustering and DBSCAN) were discussed, and the approach was suggested using sentiment analysis to determine the attitudes of users to certain social hotspots. An approach by Viljamaa (2003) recovers the hotspots of a framework by using the source code of the input framework and a set of available example applications. In this paper, they used concept analysis for uncovering hotspots of the framework. The limitation of this approach is that applying concept analysis to the entire input source code can result in a huge pattern that is not useful in practice. To address the preceding problem, their approach suggests selecting only those program elements that are relevant to the hotspot *h* at hand. Therefore, their approach requires the users to have some initial knowledge of the structure and hotspots of the framework under analysis (Thummalapenta & Xie, 2008). Ramadhan et al. (2017) implemented two classification algorithms in data mining which are C5.0 and Random Forest in order to generate model for sequence hotspot prediction on hotspot datasets in Sumatera island in 2014 and 2015. In this paper, they showed that decision tree model of C5.0 provides the best accuracy in prediction compared to rule-based model of C5.0 and Random Forest model. The major problem of this method is that models for hotspot sequences have not been verified. Chu et al. (2014) proposed the model to monitor microblog emerging outbreaks which extends a time-series form of susceptible-infectious-recovered (SIR). The limitation of this method is of little use in identifying actual hot topics. Topic model named Labeled LDA has been proposed by Ramage et al. (2009) that constrain LDA by defining a one-to-one correspondence between LDAs latent topics and tags. The limitation of their work is that each document contains one or more tags. While in fact, not all messages in microblogs contain hashtags.

As seen, a number of researches have been conducted to detect hotspots in different areas. However, research shows that very little research has been done to detect hotspot information. So that the rapid growth of information and data complicates their analyses, creates certain difficulties in detecting hotspots from this information. As, how to improve the effectiveness and efficiency of analysis of the mass information, processing as well as the accuracy and efficiency of the analysis of internet public opinion hotspots remains a hotspot for current research. Taking this into account in this study, we proposed the method to detect hotspot information and with helping it to detect the problems that public concerned. The detailed information about the method has been given in the fourth section.

3. CITIZEN SATISFACTION FROM E-GOVERNMENT SERVICES

Government agencies recognize the importance of web technologies and do a lot for the citizens to benefit from these services. E-government is one of the projects implemented for this purpose. E-government is considered the most progressive IT-services and the proper method for using online programs in world countries (Jaeger & Thompson, 2003; Daniels, 2001).

Problems such as security, accessibility, reliability, confidentiality, and civil services quality are important in the paradigm of any e-government. The rapid evolution of the e-government around the world, especially in Asia, is related to a number of convenient advantages. These include a low-cost infrastructure, better government performance, flexibility, transparency, responsibility, a wide range of online services, and so on. Data transportation via e-media is one of the key components of the e-government strategy. However, it is not enough to provide users only with information but also to implement citizen satisfaction from government services is one of the key problems (Hariguna et al., 2019; Mahmood, 2019; Bernhard et al., 2018).

Citizen satisfaction is meant as "a set of feelings and attitudes toward a number of factors affecting this or that situation". Evaluation of citizen satisfaction in the information system allows estimating

the weaknesses and strengths of the system from the user point of view. In addition, users' satisfaction means how users evaluate the information system instead of the technical quality of the system.

Evaluating the level of e-government services, the state can effectively perform debt to its citizens (Gupta & Jana, 2003; Alshehri, 2016). The determination of user satisfaction as a parameter to measure the effectiveness of e-government has a number of reasons. The first is that social media is promising and popular among users. Thus, in the context of social media, the characteristic of socialization and human integration should be defined adequately by user satisfaction. Secondly, user satisfaction aims for the adoption and implementation of e-government. Consequently, user satisfaction evaluation reveals the purpose of e-government projects. Thirdly, IT is generally not considered successful if it is not used rightly by system users. By evaluating user satisfaction, it is possible to determine how the system is accepted among users. Fourthly, developing the use of e-government by providing citizen satisfaction can lead to a reduction in government processes and operations costs. Fifthly, a complete evaluation of the project can be performed through the selection of citizen satisfaction in the evaluation of information system effectiveness (Chatfield & Al Anazi, 2013; Farhan & Sanderson, 2010).

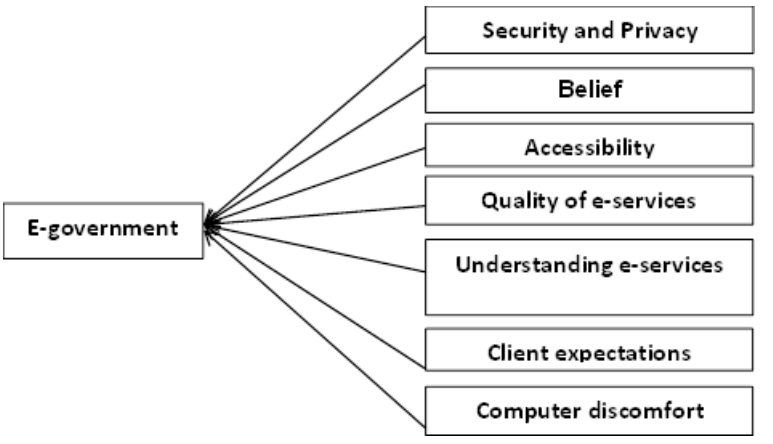
Main indicators of citizen satisfaction in the e-government portal are described in Figure 1 (Malik et al., 2016).

The e-government portal ability to provide citizens information needs affects the users view to the portal, their reconsideration and determination of satisfaction degree. So, evaluation of citizen satisfaction can help to identify the portal's or a user's failure and develop the portal and increase the number of portal users (Caroline, 2014; Danila & Abdullah, 2014). The majority of the research focuses on the technical design, service quality or proposed evaluation methods of e-government portals. We need to conduct research on the investigation of the e-government portal success from the user point of view.

4. METHOD FOR DETERMINATION OF CITIZEN SATISFACTION FROM E-GOVERNMENT SERVICES

In recent years, e-government has become a popular and common form of social media because it's convenient and simple utilise. The people who use this platform are increasing day by day. Here, it is possible to determine the interests of the people, their satisfaction and a general overview of the regions on e-services.

Figure 1. Key indicators of citizen satisfaction in e-government



It is known that the e-government portal is one of the main channels of delivery of public services and state-citizen relations. This portal contains numerous and rich information resources provided by state agencies. By utilizing these resources, it is possible to identify the most common problems that people face, what services they need for and what issues are important in the regions. By defining the problems in time, the government can make the right decisions and satisfy citizens. Because the main purpose of the state is to ensure citizens satisfaction, to raise their living standards and to overcome their basic concerns. The number of services provided by state agencies on the e-government portal is increasing day by day. It is possible to increase the efficiency of public services by identifying hotspots among these services (Twizeyimana & Andersson, 2019).

This paper proposes a method to determine the citizen satisfaction from the services provided by state agencies in the e-government environment, the hotspots between the services and to determine which regions are associated around these hotspots. We should note that some problems can be solved here (Wang, 2013; Aliguliyev & Niftaliyeva, 2016):

- Ranking state agencies (using the number of clicks on some information, according to the average time spent);
- Determination of hotspot information;
- Classification of regions according to the interests;
- Determination of hotspots and regions collected around them;
- The evaluation of the citizens and the region they belong to, etc. according to the comments.

Comprehensive information about the proposed method is given below.

Let, the number of services proposed by e-government portal is m and the number of citizens using these services is n. Let's point them as $\left(EG_1, EG_2, \ldots, EG_m\right)$ and $\left(U_1, U_2, \ldots, U_n\right)$. We should note that each service can be evaluated within a certain period of time. The number of citizens using the services and their satisfaction score can be used for this purpose. In the proposed method we will first establish a service usage vector for each user within a specific T -time period to determine the satisfaction degree of citizens for each service and to find hotspot services. Equality (1) is used for this purpose:

$$U_i = \left\{u_{i1}, u_{i2}, \ldots, u_{im}\right\}, \qquad i = 1,2,\ldots,n \tag{1}$$

where, $u_{ij}\left(i = 1,2,\ldots,n, j = 1,2,\ldots,m\right)$ represents the usage of i th user to the j th – servise. Note that, here every element u_{ij} is a two-dimensional vector:

$$u_{ij} = \left(u_{ij,1}, u_{ij,2}\right) \tag{2}$$

where, $u_{ij,1}$ denotes the number of usages from the j-th service by the i-th user, and $u_{ij,2}$ is the satisfaction element from the service. It should be noted two variants are possible here: 1) A number of service usage is not taken into account; 2) A number of service usage is taken into account.

In the first variant, a number of service usage is not taken into account. It means that the number of usages from the service is not considered, we only take into account if they use the service or not. If the citizen has used the service, it is evaluated by 1, if not then by 0:

if the i-the user has used j-th service,

$$u_{ij,1} = \begin{cases} 1, \\ 0, \end{cases} \tag{3}$$

otherwise
The scale [1.5] is recommended to evaluate the degree of citizens satisfaction from services:

$$u_{ij,2} = \begin{cases} 1 & \text{very poor} \\ 2 & \text{poor} \\ 3 & \text{normal} \\ 4 & \text{good} \\ 5 & \text{very good} \end{cases} \tag{4}$$

Let's note that if the user has not used the service, then the service vector is accepted as $u_{ij} = (0,0)$.

Considering (2), we can present a citizens usage matrix from services in the following way:

$$U = \begin{Vmatrix} u_{11} & \cdots & u_{1m} \\ \vdots & \ddots & \vdots \\ u_{n1} & \cdots & u_{nm} \end{Vmatrix} = \begin{Vmatrix} (u_{11,1}, u_{11,2}) & \cdots & (u_{1m,1}, u_{1m,2}) \\ \vdots & \ddots & \vdots \\ (u_{n1,1}, u_{n1,2}) & \cdots & (u_{nm,1}, u_{nm,2}) \end{Vmatrix} \tag{5}$$

We can sum up the similar elements of these vectors on the rows after establishing of each users' vector within services. This can help us to determine how much the citizens are in need of every service and their satisfaction from these services. In this case, each e-service $EG_j (j = 1,2,\ldots,m)$ can be expressed in the form of two-dimensional vectors:

$$EG_j = \sum_{i=1}^{n} u_{ij} = \left(\sum_{i=1}^{n} u_{ij,1}, \sum_{i=1}^{n} u_{ij,2} \right) = (u_{j,1}, u_{j,2}) \qquad j = 1,2,\ldots,m \tag{6}$$

where, the first element of the vector $u_{j,1}$ - is the total number of usages from the j-th service, and the second element $u_{j,2}$ is the total satisfaction degree from it. By using (6), we can estimate the average satisfaction degree from the j-th service. For this purpose, we propose to use the following equation:

$$EG_j^{savg} = \frac{u_{j,2}}{u_{j,1}} \tag{7}$$

where, EG_j^{savg} represents the average satisfaction degree from the j-th service. If we make ranking according to EG_j^{savg} (in descending order), we will obtain citizen satisfaction rating from services.

The second variant we consider the number of service usage. It means that the same citizen may use the service several times and regularly evaluate the service with different satisfaction scores. In this case, the average satisfaction rating of e-services will be performed in the following way.

Considering the number of usages from the service, we can present the usage vector as the following:

$$u_{ij} = \left(u_{ij,1}, u_{ij,2}\right) = \left(N_{ij}, \sum_{k=1}^{N_{ij}} u_{ij,2}^{k}\right) = \left(N_{ij}, u_{ij,2}^{£}\right) \tag{8}$$

where N_{ij} is the number of usages of i-th user from the j-th service, $u_{ij,2}^{k}$ is the satisfaction score using in k-th time, and $u_{ij,2}^{\Sigma}$ is the total satisfaction score given by i-th user to the j-th service. Using (8), we also can determine the average satisfaction degree of the i-th user from j-th service:

$$u_{ij}^{savg} = \frac{u_{ij,2}^{\Sigma}}{N_{ij}} \tag{9}$$

Then, the Matrix (5) is represented as follows:

$$U = \begin{Vmatrix} u_{11} & \dots & u_{1m} \\ \vdots & \ddots & \vdots \\ u_{n1} & \dots & u_{nm} \end{Vmatrix} = \begin{Vmatrix} \left(N_{11}, u_{11}^{savg}\right) & \dots & \left(N_{1m}, u_{1m}^{savg}\right) \\ \vdots & \ddots & \vdots \\ \left(N_{n1}, u_{n1}^{savg}\right) & \dots & \left(N_{nm}, u_{nm}^{savg}\right) \end{Vmatrix} \tag{10}$$

According to it, we can express (6) as follows:

$$EG_j = \sum_{i=1}^{n} u_{ij} = \left(\sum_{i=1}^{n} N_{ij}, \sum_{i=1}^{n} u_{ij,2}^{\Sigma}\right) = \left(N_j, u_{j,2}^{£}\right) \tag{11}$$

Considering the number of usages as in (11), we can determine the average satisfaction degree from each service:

$$EG_j^{savg} = \frac{u_{j,2}^{\Sigma}}{N_j} \tag{12}$$

We will get citizens satisfaction rating from services if we conduct a ranking according to EG_j^{savg}.

We can also find the average satisfaction degree of each user from all services:

$$u_i^{savg} = \frac{1}{m} \sum_{j=1}^{m} u_{ij}^{savg} \tag{13}$$

where u_i^{savg} denotes the satisfaction degree of the i-th user from all services.

In this case, the average satisfaction degree of all users from e-services is expressed as follows:

$$U^{savg} = \frac{1}{n}\sum_{i=1}^{n} u_i^{savg} \tag{14}$$

where, U^{savg} defines the average satisfaction degree of users from e-services. Through (14), the e-system is evaluated entirely. When we say an e-system, we mean e-government platform.

We can also conduct a regional evaluation of each service. Accordingly, we can determine which regions are more using the services and do they satisfy from them. u_{ij}^{savg} can be used for this purpose. So, if we conduct a ranking according to u_{ij}^{savg}, we will get the users satisfaction rating from j-th service. After ranking, we can divide the rating table into three sections according to (4): $U_j^- \left(\text{not satisfied}\right), U_j^0 \left(\text{satisfied}\right), U_j^+$ (very satisfied). Here U_j^- is a user group which satisfaction scores from j-th service is in [1,2], U_j^0 is in [2,4), U_j^+ is in [4,5] interval.

After the determination of the user groups, we will look through the intersection of these groups within services:

$$\begin{aligned} U^- &= \bigcap U_j^- \\ U^0 &= \bigcap U_j^0 \\ U^+ &= \bigcap U_j^+ \end{aligned} \tag{15}$$

where U^- is dissatisfied, U^0 is satisfied, U^+ is very satisfied users group from all services. We can associate a citizen to the region who uses each service. Considering that each user has their own IP address, it is possible to determine automatically which regions the dissatisfied and satisfied citizens belong to according to the Equation (15). Possibly, these citizens are gathered in one region or distributed over the regions.

We can also determine the common interest of the regions. So, we are able to determine the hotspot services for the regions by defining the services that each region uses and the rating of these services. For this purpose, we divide $\left(U_1, U_2, \ldots, U_n\right)$ users into regions through IP as mentioned above. By using (8), the services used by each user (region) are defined. Ranking the services requested by the users from the same region (in decreasing order), we will obtain usage rating of the service. Based on this rating, services most commonly addressed by users from the same region are identified. E-service interests of the regions are automatically assigned from here.

As seen, the proposed method identifies the regions satisfied with the services, including the services are in need. It is important in developing citizen satisfaction in the regions and raising confidence in the state. Thus, the government can provide citizens satisfaction by defining problems in time and making the appropriate decisions.

5. EXPERIMENT AND RESULTS

To evaluate the proposed method the calculations were performed in the Matlab 2018.

Let, the scores presented the number of usages from e-services in a certain time interval and the satisfaction degree with these services is described in Table 1.

Table 1. Number of usages from services and their total scores

Users	E-Services				
	EG_1	EG_2	EG_3	EG_4	EG_5
U_1	(41, 82)	(33, 44)	(22,80)	(38,76)	(17,34)
U_2	(46,153)	(1, 4)	(19,69)	(13,43)	(42,112)
U_3	(6,16)	(43,129)	(39,104)	(25,100)	(29,106)
U_4	(46,107)	(47,156)	(40,106)	(35,128)	(28,56)
U_5	(32,64)	(34,124)	(9,30)	(45,45)	(46,214)
U_6	(4,13)	(38,152)	(24,64)	(48,80)	(14,46)
U_7	(14,56)	(37,86)	(22,58)	(27,90)	(38,126)
U_8	(27,108)	(20,40)	(32,96)	(7,32)	(38,139)
U_9	(48,192)	(33,88)	(36,72)	(7,11)	(19,76)
U_{10}	(49,130)	(8,32)	(38,126)	(13,43)	(28,46)
U_{11}	(8,24)	(36,96)	(14,46)	(42,98)	(3,11)
U_{12}	(49,98)	(1,3)	(34,90)	(12,32)	(2,7)
U_{13}	(48,160)	(14,28)	(33,132)	(41,123)	(27,117)
U_{14}	(24,88)	(2,7)	(8,26)	(12,32)	(39,78)
U_{15}	(40,146)	(4,5)	(6,20)	(47,125)	(47,141)
U_{16}	(7,21)	(41,41)	(25,91)	(17,39)	(6,8)
U_{17}	(21,56)	(35,105)	(48,112)	(10,40)	(29,106)
U_{18}	(46,168)	(16,32)	(17,45)	(12,32)	(23,69)
U_{19}	(40,53)	(48,144)	(29,87)	(31,103)	(0,0)
U_{20}	(48,112)	(1,2)	(11,25)	(24,56)	(17,45)

The first number of each vector given in Table 1 is the total number of each user's usages from the service, and the second one is the total satisfaction score given to it. Note that the regions that the users belong to are described in Table 2.

Using Table 1, the average satisfaction scores of each service given by each user are calculated via the Equation (9). The results of the calculations are given in Table 3.

Then, to find the satisfaction rating of services, the average satisfaction scores of all users from the services were calculated by the Equation (12). So, the total number of usages from each service

Table 2. Distribution of users by the regions

Regions	Users
R_1	U_2, U_5, U_7, U_{14}, U_{15}
R_2	U_1, U_9, U_{19}, U_{20}
R_3	U_8, U_{11}, U_{12}
R_4	U_3, U_4, U_{10}, U_{13}
R_5	U_6, U_{16}, U_{17}, U_{18}

Table 3. Average satisfaction score of each user from services

Users	EG_1	EG_2	EG_3	EG_4	EG_5
U_1	2.0000	1.3333	3.6364	2.0000	2.0000
U_2	3.3261	4.0000	3.6316	3.3077	2.6667
U_3	2.6667	3.0000	2.6667	4.0000	3.6552
U_4	2.3261	3.3191	2.6500	3.6571	2.0000
U_5	2.0000	3.6471	3.3333	1.0000	4.6522
U_6	3.2500	4.0000	2.6667	1.6667	3.2857
U_7	4.0000	2.3243	2.6364	3.3333	3.3158
U_8	4.0000	2.0000	3.0000	4.5714	3.6579
U_9	4.0000	2.6667	2.0000	1.5714	4.0000
U_{10}	2.6531	4.0000	3.3158	3.3077	1.6429
U_{11}	3.0000	2.6667	3.2857	2.3333	3.6667
U_{12}	2.0000	3.0000	2.6471	2.6667	3.5000
U_{13}	3.3333	2.0000	4.0000	3.0000	4.3333
U_{14}	3.6667	3.5000	3.2500	2.6667	2.0000
U_{15}	3.6500	1.2500	3.3333	2.6596	3.0000
U_{16}	3.0000	1.0000	3.6400	2.2941	1.3333
U_{17}	2.6667	3.0000	2.3333	4.0000	3.6552
U_{18}	3.6522	2.0000	2.6471	2.6667	3.0000
U_{19}	1.3250	3.0000	3.0000	2.3333	0
U_{20}	2.3333	2.0000	2.2727	5.0000	2.6471

and the total satisfaction rating given to them were used. The results of the calculations are given in Table 4.

As seen in Table 4, the average satisfaction score given to services is close to each one. Using these values, we can find the satisfaction rating for services (Figure 2).

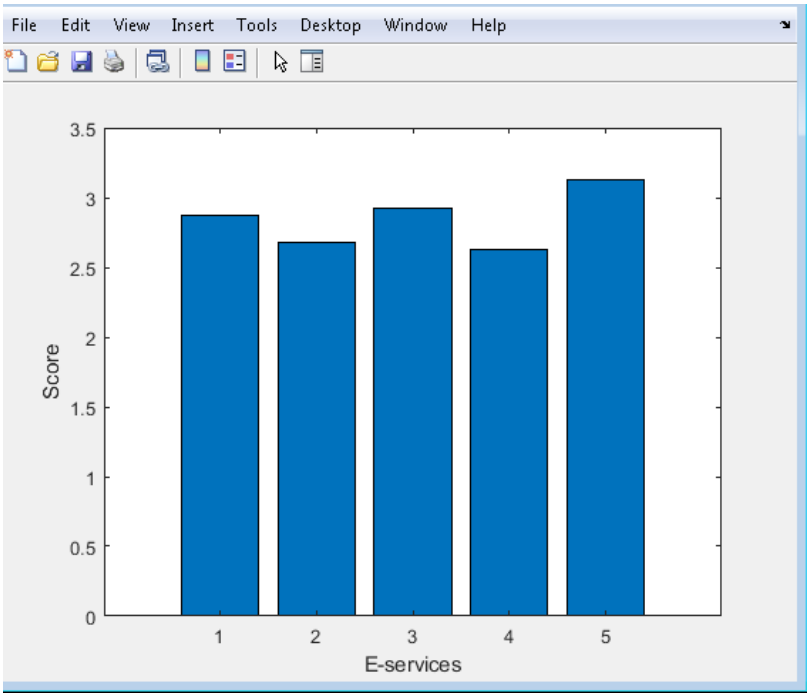
Then, the total satisfaction degree from all services by each user was calculated:

u_i^{savg} = [2.1939 3.3864 3.1977 2.7905 2.9265 2.9738 3.1220 3.4459 2.8476 2.9839 2.9905 2.7628 3.3333 3.0167 2.7786 2.2535 3.1310 2.7932 2.1295 2.3173]

Table 4. Average satisfaction scores given to each service by all users

E-Services	Number of Requests	Total Score	Average Satisfaction Score
EG_1	644	1847	2.8680
EG_2	492	1318	2.6789
EG_3	506	1479	2.9229
EG_4	506	1328	2.6245
EG_5	492	1537	3.1240

Figure 2. E-services satisfaction rating



The calculations results are illustrated in Figure 3.

Then, using these calculations, the e-system was generally evaluated:

$$U^{savg} = \frac{1}{20} * \left(2.1939 + 3.3864 + \ldots + 2.3173\right) = 2.8687$$

The system's performance can be considered "satisfying" because of the $U^{savg} = 2.8687$ total satisfaction degree from the system being in [2,4) interval.

To find the user groups satisfied and dissatisfied from all services, Table 3 was used to conduct a ranking. Based on this ranking, dissatisfied, satisfied and more satisfied user groups were identified according to the score given by them (Table 5).

Looking through the intersection of these services within all services, there exist, satisfied users, while there are no dissatisfied or more satisfied users from all the services as seen in Table 5. So, $\left\{u_4, u_{11}, u_{12}, u_{14}, u_{18}\right\}$ are the users that more satisfied with all services. Looking at the regions that the users belong to in Table 2, we will observe the satisfaction of $\left\{R_1, R_3, R_4, R_5\right\}$ regions from all the services.

Table 1 has been used to identify the interest of the regions. Thus, hotspot services for the regions have been defined by ranking after determining the services frequently used by the users from the same region. Note that the *U.num* indicates the number of usages in the table. When we say the request number we mean the maximum number of users request to each service. The results of these calculations are described in Table 6.

Figure 3. Users rating

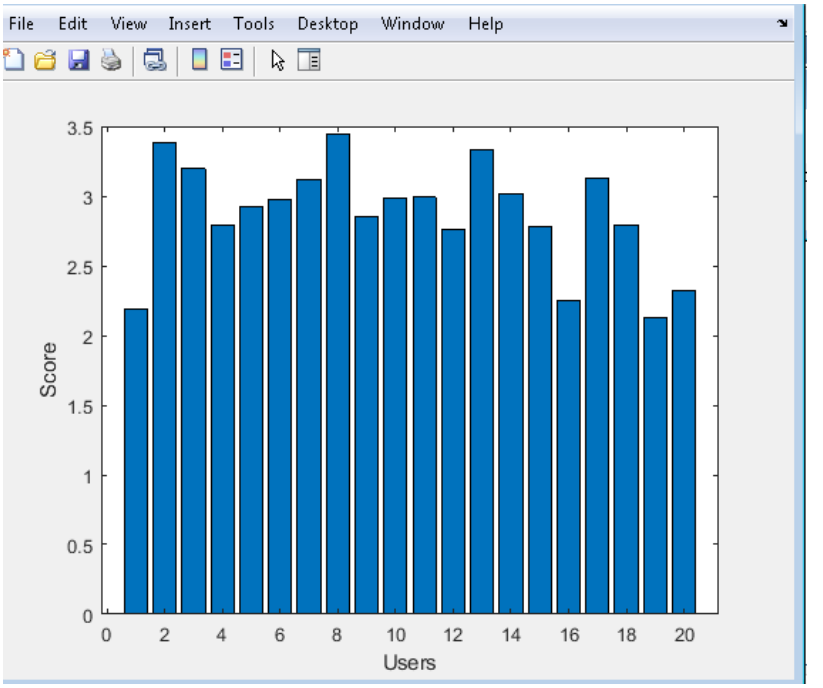


Table 5. Satisfaction of user groups within services

	EG_1	EG_2	EG_3	EG_4	EG_5
Dissatisfied	U_{19}	U_1 U_{15} U_{16}	-	U_5 U_6 U_9	U_{10} U_{16} U_{19}
Satisfied	U_1 U_2 U_3 U_4 U_5 U_6 U_{10} U_{11} U_{12} U_{13} U_{14} U_{15} U_{16} U_{17} U_{18} U_{20}	U_2 U_3 U_4 U_5 U_7 U_8 U_9 U_{11} U_{12} U_{13} U_{14} U_{17} U_{18} U_{20}	U_1 U_2 U_3 U_4 U_5 U_6 U_7 U_8 U_9 U_{10} U_{11} U_{12} U_{14} U_{15} U_{16} U_{17} U_{18} U_{19} U_{20}	U_1 U_2 U_4 U_7 U_{10} U_{11} U_{12} U_{14} U_{15} U_{16} U_{18} U_{19}	U_1 U_2 U_3 U_4 U_6 U_7 U_8 U_9 U_{11} U_{12} U_{14} U_{15} U_{17} U_{18} U_{20}
More satisfied	U_7 U_8 U_9	U_2 U_6 U_{10}	U_{13}	U_3 U_8 U_{17} U_{20}	U_5 U_9 U_{13}

Table 6. Hotspot services for regions

Services	Region 1		Region 2		Region 3		Region 4		Region 5	
	U.num	*Rank*	*U.num*	*Rank*	*U.num*	*Rank*	*U.num*	*Rank*	*U.num*	*Rank*
EG_1	46	***3***	48	***1***	49	***1***	49	***1***	46	***3***
EG_2	37	***4***	48	***2***	36	***4***	47	***2***	41	***4***
EG_3	22	***5***	36	***4***	34	***5***	40	***4***	48	***1***
EG_4	47	***2***	38	***3***	42	***2***	41	***3***	48	***2***
EG_5	47	***1***	19	***5***	38	***3***	29	***5***	29	***5***

Thus, the service satisfaction rating, the user total satisfaction rating from all services, only the regions satisfied and dissatisfied from all services, the interest of these regions, and the e-system was generally evaluated.

As a result of the experiment, the satisfaction degree of 20 users from 5 regions within 5 services, also a common interest of these regions has been defined. The calculation results showed that the e-services satisfaction rating was close to each one. However, the differences in user satisfaction rating for all services have been defined. The overall performance of the system, i.e. the total satisfaction degree from the system, is considered "satisfying". It was discovered that there were not dissatisfied or more satisfied users with all services. However, we observed the satisfied users and determined that they were distributed over 4 regions. Finally, hotspot services for regions were identified.

6. CONCLUSION

At present, one of the important tasks of e-government is to provide citizen satisfaction. For this purpose, government implements a number of policies. But the problem is not still resolved. Citizen satisfaction could be ensured by involving citizens in the decision-making process. Citizens could be involved in the decision-making process by defining hotspot information in e-government. Using hotspot information, agencies could expand the participation of people in the decision-making process. As a result of the discovery of hotspot information that is of public interest in the e-government, the state may provide more targeted information and services to the public. Considering these, in the paper a method was proposed to determine the satisfaction degree of citizens from services in the e-government, to identify hotspots among them and automatically to detect the interest of the regions. Satisfaction ratings of e-services and user have been identified by the proposed method. For this purpose, the number of usages from the services and satisfaction scores were used. Then, the satisfied and dissatisfied regions were identified and a general overview of the regions about the services was described.

The main goal of this method is as follows:

- To increase the citizen satisfaction from the services through the feedback mechanism;
- Detection of hotspot services;
- Identify areas of interest of regions in e-government;
- Classification of public services through the citizen satisfaction degree;
- Improve e-governance, and e-government system.

However, given the limited capacity, this research is still relatively shallow. In this method, it is assumed that there is an evaluation scale in the system. Nevertheless, how will the system work if there is no evaluation scale in the system? To solve this problem, the accuracy of the method can

be improved by using the capabilities provided by text mining technologies. Thus, if the system does not have an evaluation scale, the user can express his / her opinion in the text. User satisfaction could be determined through the analyzing of these texts using the text mining technologies. These are the directions of our future researches. We will use more factors in our future work to evaluate user satisfaction and compare it with other methods. And, besides, we will develop more efficient algorithms related to hotspot information.

ACKNOWLEDGMENT

This work was supported by the Science Development Foundation under the President of the Republic of Azerbaijan – Grant No EIF-BGM-4-RFTF-1/2017-21/08/1.

REFERENCES

Aliguliyev, R. M., & Niftaliyeva, G. Y. (2016). Hotspot information of public opinion in e-government. In *Processing of the 10th International Conference Application of Information and Communication Technologies* (pp. 645-646). Academic Press.

Alshehri, A. (2016). Measuring User Satisfaction with e-Government Systems: An Empirical Study to Evaluate IS Effectiveness [Doctoral Thesis].

Anthopoulos, L., & Sirakoulis, K. (2015). E-government portal updates' evaluation: A comparative analysis. *International Journal of Public Administration in the Digital Age*, *2*(4), 54–74. doi:10.4018/ijpada.2015040104

Bernhard, I., Norström, L., Snis, U. L., Gråsjö, U., & Gellerstedt, M. (2018). Degree of Digitalization and Citizen Satisfaction: A Study of the Role of Local e-Government in Sweden. *The Electronic. Journal of E-Government*, *16*(1), 59–71.

Caroline, M. (2014). Evaluating citizen satisfaction with the quality of e-government information services provided by Southern Africa Development Community governments. Retrieved from https://pdfs.semanticscholar.org/bf40/9f935f371dfd53735f85216950438fd8f02c.pdf

Chaovalit, P., & Zhou, L. (2005). Movie review mining: a comparison between supervised and unsupervised classification approaches. In *Proceedings of the 38th Hawaii International Conference on System Sciences* (pp. 1-9). IEEE Press. doi:10.1109/HICSS.2005.445

Chatfield, A., & AlAnazi, J. (2013). Service quality, citizen satisfaction, and loyalty with self-service delivery options to transforming e-government services. In *Processing of the 24th Australasian Conference on Information Systems* (pp. 1-11). Academic Press.

Chu, V. W., Wong, R. K., Chen, F., & Chi, C. H. (2014). Microblog Topic Contagiousness Measurement and Emerging Outbreak Monitoring. In *Proceedings of the 23rd ACM International Conference on Conference on Information and Knowledge Management* (pp. 1099–1108). ACM. doi:10.1145/2661829.2662014

Córdoba-Pachón, J.-R. (2015). Systems thinking to improve e-government evaluation. *International Journal of Public Administration in the Digital Age*, *2*(4), 1–15. doi:10.4018/ijpada.2015100101

Daniels, E. D. (2001). Memoranda 01–28 (Citizen-centered e-government: Developing the action plan). Whitehouse.gov. Retrieved from http://www.whitehouse.gov/omb/memoranda_m01-28

Danila, R., & Abdullah, A. (2014). User's satisfaction on e-government services: An integrated model. In *Processing of the International Conference on Accounting Studies* (pp. 575-582). Academic Press.

Delone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems*, *19*(4), 9–30. doi:10.1080/07421222.2003.11045748

Farhan, H. R., & Sanderson, M. (2010). User's Satisfaction of Kuwait E-Government Portal; Organization of Information in Particular. In *Processing of the International Conference on E-Government, E-Services and Global Processes. AICT-334* (pp. 201-209). Academic Press.

Ghahramani, M., & Hon, Ch. T. (2018). Mobile Phone Data Analysis: A Spatial Exploration Toward Hotspot Detection. *Journal of the IEEE Transactions on Automation Science and Engineering*, *99*, 1–12.

Gupta, M. P., & Jana, D. (2003). E-government evaluation: A framework and case study. *Government Information Quarterly*, *20*(4), 365–387. doi:10.1016/j.giq.2003.08.002

Hariguna, T., Hung, Ch.-W., & Sukmana, H. T. (2019). The antecedent of citizen intention use of e-government service. *TELKOMNIKA*, *17*(1), 202–209. doi:10.12928/telkomnika.v17i1.11588

Jaeger, P. T., & Thompson, K. M. (2003). E-government around the world: Lessons, challenges, and future directions. *Government Information Quarterly*, *20*(4), 389–394. doi:10.1016/j.giq.2003.08.001

Li, N., & Wu, D. D. (2010). Using text mining and sentiment analysis for online forums hotspot detection and forecast. *Journal of Decision Support Systems*, *48*(2), 354–368. doi:10.1016/j.dss.2009.09.003

Mahmood, M. (2019). Transformation of Government and Citizen Trust in Government: A Conceptual Model. In Strategic Management and Innovative Applications of E-Government (pp. 107-122). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-6204-7.ch005

Malik, B. H., & Mastoi, A. (2016). Evaluating Citizen e-Satisfaction from e-Government Services: A Case of Pakistan. *European Scientific Journal*, *12*(5), 346–370. doi:10.19044/esj.2016.v12n5p346

Ming, C., Chen, T., & Ai, Q. (2018). An empirical study of e-service quality and user satisfaction of public service centers in China. *International Journal of Public Administration in the Digital Age*, *5*(3), 43–59. doi:10.4018/IJPADA.2018070104

Noto, L. (2015). E-government's role in shifting the paradigm of performance in the public sector. *International Journal of Public Administration in the Digital Age*, *2*(4), 29–45. doi:10.4018/ijpada.2015100103

Qin, K., Zhou, Q., Wu, T., & Xu, Y. Q. (2017). Hotspots Detection from Trajectory Data Based on Spatiotemporal Data Field Clustering. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *42*(2), 18–22.

Ramadhan, M. M., Sitanggang, I. S., & Anzani, L. P. (2017). Classification model for hotspot sequences as indicator for peat land fires using data mining approach. *International Journal of Science and Technology*, *3*(2), 588–597.

Ramage, D., Hall, D., Nallapati, R., & Manning, C. D. (2009). Labeled LDA: A supervised topic model for credit attribution in multi-labeled corpora. In *Proceedings of the 2009 Conference on Empirical Methods in Natural Language Processing* (pp. 248–256). Academic Press. doi:10.3115/1699510.1699543

Stojanovski, D., Chorbev, I., Dimitrovski, I., & Madjarov, G. (2016). Social Networks VGI: Twitter Sentiment Analysis of Social Hotspots. In European Handbook of Crowdsourced Geographic Information (pp. 223–235). Academic Press.

Thelwall, M., Buckley, K., & Paltoglo, G. (2011). Sentiment in Twitter Events. *Journal of the American Society for Information Science and Technology*, *62*(2), 406–418. doi:10.1002/asi.21462

Thelwall, M., Buckley, K., Paltoglou, G., Cai, D., & Kappas, A. (2010). Sentiment strength detection in short informal text. *Journal of the American Society for Information Science and Technology*, *61*(12), 2544–2558. doi:10.1002/asi.21416

Thummalapenta, S., & Xie, T. (2008, September). Spotweb: Detecting framework hotspots and coldspots via mining open source code on the web. In *Proceedings of the 2008 23rd IEEE/ACM International Conference on Automated Software Engineering* (pp. 327-336). IEEE Computer Society.

Twizeyimana, J. D., & Andersson, A. (2019). The public value of E-Government – A literature review. *Government Information Quarterly*, *36*(2), 167–178. doi:10.1016/j.giq.2019.01.001

Viljamaa, J. (2003). Reverse Engineering Framework Reuse Interfaces. In *Proceedings of the 9th European Software Engineering Conference held jointly with 11th ACM SIGSOFT International Symposium on Foundations of Software Engineering (ESEC/FSE)* (pp. 217–226). New York: ACM. doi:10.1145/940071.940101

Wang, G. (2013). Research on Hotspot Discovery in Internet Public Opinions Based on Improved K-Means. *Journal of Computational Intelligence and Neuroscience*, 1–6. doi:10.1155/2013/230946 PMID:24106496

Wang, J., Li, L., Tan, F., Zhu, Y., & Feng, W. (2015). Detecting Hotspot Information Using Multi-Attribute Based Topic Model. *Journal of PLoS ONE*, *10*(10), 1–16. doi:10.1371/journal.pone.0140539 PMID:26496635

Wang, S., Zhang, J., Yang, F., & Ye, J. (2013). Research on Cluster Analysis Method of E-government Public Hotspot Information Based on Web Log Analysis. *CIT. Journal of Computing and Information Technology*, *22*, 11–19. doi:10.2498/cit.1002281

Ya, B. T. (2009). Research on public opinion hotspot detection based on SVM. *Science and Technology Management Research*, *25*(2), 64–69.

Gunay Yaver Iskandarli received her BSc and MSc in applied mathematics from the Baku State University, Azerbaijan in 2012 and 2014, respectively. She is currently a PhD student at the Institute of Information Technology of ANAS. Her research interests include: e-government, online social networks, text mining, data mining, and Big Data analytics. She is the author of 15 papers and 1 book.