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PANIC BUTTON MOBILE APPLICATION USABILITY STUDY

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ABSTRACT: It is inevitable that technology, which enters all areas of our lives, is also used in disaster and emergency management. The frequent use of smartphones has led to the development of emergency applications for mobile phones. The usability of applications, which are vitally important to be used easily in emergency situations, should be at a high level. In this study, the “Panic Button” application, which was developed for use on smartphones in emergency situations, was subjected to heuristic evaluation and the evaluation results were shared. By applying the System Usability Scale with the help of heuristic evaluation, significant and fast feedback was received and this feedback was provided to increase the usability of the “Panic Button" application for emergency situations. It is aimed to prevent errors and to provide an environment where users can communicate quickly by recommending the help and documentation information of the “Panic Button” application.

Keywords: Usability, Emergency Mobile Application, Heuristic Evaluation, System Usability Scale.

1. INTRODUCTION

As in all fields of our lives, adaptation to an emergency is inevitable as well [1]. Applications that enable people to contact the person trapped under the rubble after an earthquake catastrophe or request a call for help for the evacuation of individuals trapped in a flood disaster can be demonstrated as an example.

Along with the use of emergency applications to be developed, many potential hazards can be prevented or the resulting damages can be minimized [1]. In today’s world where technology enters every field, the usage of smartphones has become an indispensable part of individuals' lives. Studies indicate that more than 90% of adults in Turkey use mobile phones, while more than 75% of them use smartphones [2-3]. Mobile-based emergency software will have augmented their usage when considering that mobile phones are widely used [4]. The fact that users can get the help they need swiftly by pressing a few buttons depends upon the ability of mobile applications to perform the expected function and to be easily used in emergencies, briefly, to have a high level of usability.

The set of attributes that measures quality based on how easy the user interface is to use is called usability [5]. ISO 9241-11:2018 standard; defines efficiency, satisfaction, and effectiveness as a consequence of the usage of a particular product as usability [6]. Measuring usability bridges over determining how usable the system is (e.g., effective, efficient, easy to learn) from the users' perspective, whether there are any issues to fix or not, and monitoring the performance of the system design over time [6-7]. The usability of a system can be measured through different measurement tools. As measurement tools, they can be used in different methods and models such as expert-based and user-based methods that are widely applied in the literature [8]. Studies with heuristic evaluation and user tests, which are usability evaluation tools, are escalating day by day. These studies provide information to software developers about the usability of interfaces. While there are many studies on usability in the literature, it is seen that there are fewer studies on applications used in emergencies [9]. With the increase in mobile applications used in our daily life, studies to evaluate the usability of these applications have also been made academically [10-11]. An investigation-based heuristic that defines usability principles was developed by Nielsen and Molish (1990) to examine the design interfaces of applications and evaluate their usability [11]. This developed method; is widely used due to its low cost, low resource consumption, efficiency, and accurate results [12].

In the literature, there are many studies conducted with the heuristic evaluation method to determine how easily and efficiently the applications are used [13]. Gómez et al. (2013) examine how more than 250 mobile applications that can be used in emergencies are used, by reviewing their innovation possibilities, functional features, and usability. In addition to this analysis, the “Citizen Emergency Management” mobile application is proposed for the functional design [14]. Sarlan et al. (2016) tested a mobile application by developing in which 10 heuristics of Nielsen were integrated, so that eyewitnesses could send accident warnings and notifications to the emergency call center in case of a traffic accident. As a result of the usability test, it has been observed that the prototype of the application complies with the usability principles, is easy to use, and gives positive results for the users [9]. Repanovici & Nedelcu (2020) evaluated three methods that can be used to communicate with field experts in emergency situations by addressing Voice Calls, SMS, and mobile applications. In the evaluation process, a multi-criteria analysis method was used. As a result of the findings obtained, they stated that mobile applications are the most ideal solutions for communicating in an emergency situation. Furthermore, the current status, future potentials and obstacles of mobile applications used for emergency notifications have been discussed [15]. In the literature, studies are discerned on application titles that will convey the correct information to the emergency center [9,14-15]. However, in the studies, it was seen that the evaluations made by the experts were not made together with Nielsen's heuristic evaluation and usability evaluation scales.

In this study, the Panic Button application developed by Pronet company for mobile devices was evaluated by taking the opinions of experts with the heuristic evaluation method suggested by Nielsen and Molich (1990) [16-17]. Besides, the usability of the application was measured with the help of the System Usability Scale (SUS), which was developed by Brooke (1996) and adapted to Turkish by Çağıltay (2011) [18-19]. In the studies that exist in the literature, evaluation is made using only Nielsen's heuristics or SUS. On the other hand, in this study, Nielsen's heuristic evaluation method and SUS were used together and evaluated by experts and more consistent results were obtained. In addition, while studies on mobile applications developed for emergencies usually present prototypes, in this study, a commercially developed and in-use mobile application was evaluated. Obtained results and expert opinions were compiled and presented.

2. METHOD

This study, which aims to evaluate the availability of the Panic Button application developed for mobile devices, was carried out as an expert-based assessment using expert opinions from heuristic evaluation methods and a SUS from usability scales. Within the scope of the study, an unaccustomed hybrid evaluation method was introduced in the literature by combining the steps of mapping the site of the Panic Button application, Nielsen's heuristics and system usability scale and obtaining expert opinions. It was preferred in this study to obtain expert opinions that constitute the first part of the proposed system given that it saves time and can be obtained in such a short time.

It is known that there should be at least 3 participants in the heuristic assessment made with expert opinion and that 5 participants may be adequate to detect an average of 75% of the problems [20]. Respectively, field specialists have heuristic evaluation methods made. Then, quantitative data were inference by applying the SUS to the experts [19].

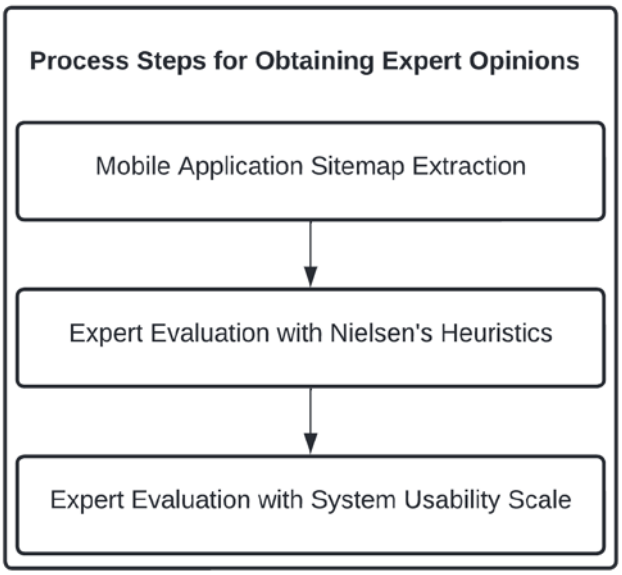

Figure 1. Process Steps for Obtaining Expert Opinions.

The process steps for obtaining expert opinions shown in Figure 1 are explained in detail in the following headings.

2.1. Mobile Application Site Map

The mobile application sitemap specified in Figure 2 is designed to provide a more comfortable view of the components/screens to be evaluated. Using Nielsen's Heuristics mentioned in Table 1, experts were able to evaluate the entire screens appropriately and thoroughly thanks to the prepared sitemap.

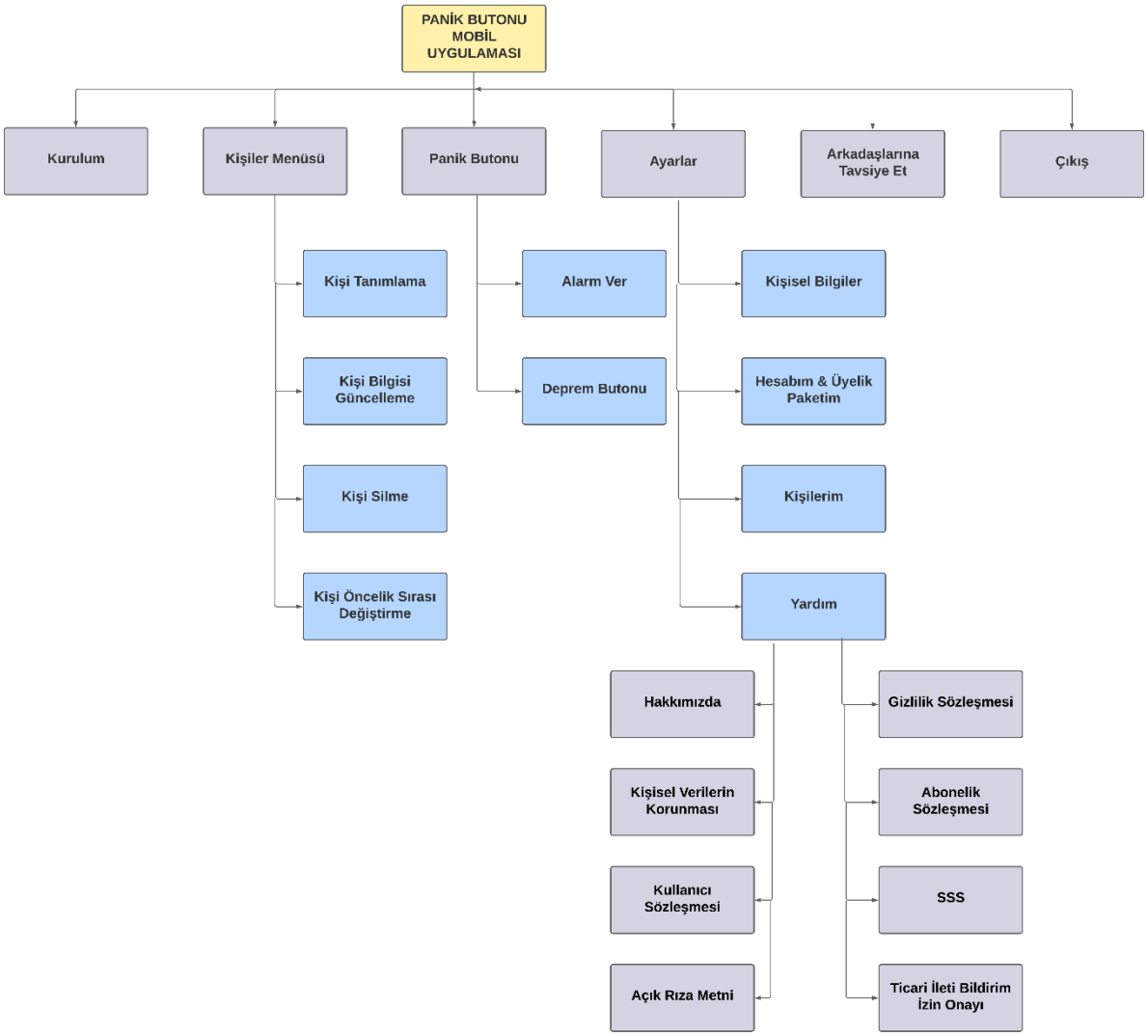

Figure 2. Mobile Application Site Map

2.2. Heuristic Evaluation and Expert Opinions

After the screens/components that should be mapped and evaluated were determined, the heuristic evaluation phase was established. During the heuristic evaluation phase, Nielsen's 10 heuristics, shown in Table 1, were used. It was reported by Nielsen (1994) that three or five specialists will be sufficient to assess the availability of a system [20].

Table 1. Nielsen's Heuristics [27]

Name of Heuristics
Visibility of system status
Matching between system and the real world
User control and freedom
Consistency and standards
Error prevention
Recognition rather than recall
Flexibility and efficiency of use
Aesthetic and minimalist design
Recognize, diagnose, and recover from errors
Help and documentation

- Visibility of system status: Evaluation of keeping users informed of what is happening uninterruptedly within a reasonable time using appropriate notifications.
- Matching between system and the real world: Evaluating the existence of concepts, words, and phrases that the last user can simply understand.
- User control and freedom: It is the reversal of unintentional actions or the evaluation of the control of the actions that can be conducted within the system.
- Consistency and standards: It is the assessment of the consistency of different situations, actions, or words within the system.
- Error prevention: It is the evaluation of preventing the occurrence of errors and providing a mechanism to approve actions, rather than the error messages that should be shown to the user.
- Recognition rather than recall: It is the evaluation of presenting all the options and information required for the relevant action, instead of waiting for users to remember an action on the application.
- Flexibility and efficiency of use: Evaluating that novice users experience as comfortable and efficient as expert users.
- Aesthetic and minimalist design: It is the evaluation of being visually beautiful and free from unnecessary details.
- Recognize, diagnose, and recover from errors: Evaluating that the errors that occur are clearly expressed in plain language.
- Help and documentation: Evaluation of user guidance when it is necessary.

2.3 System Usability Scale and Its Application to Experts

The System Usability Scale (SUS) is used to evaluate the usability of different types of products, such as websites, software, or hardware [19,23-26]. SUS, which is a 5-point Likert type scale, consists of 10 items. In SUS, each question scales from 1 (strongly disagree) to 5 (strongly agree). The SUS score, which is calculated with the formula shown in equation 1, is subtracted from 1 for odd-numbered items, and 5 for even-numbered items. Then, the sum of the items is multiplied by 2.5 to get a total score.

In this way, it makes it easier for inexperienced people to understand the (SUS) scores scaled between 0 and 100 [25]. Brooke (1996) showed that high scores obtained as a result of the implementation of the SUS have positive effects on system usability. SUS scores can be thought of as a 100-point rating scale used in academic evaluations. For example, the 90–100 range in SUS is mapped to the A grade, and the 80–89 range to the B grade [24,26].

$$SUS = \left(\sum_{\substack{i=1 \\ i \bmod 2=1}}^{10} (si - 1) + \sum_{\substack{i=1 \\ i \bmod 2=0}}^{10} (5 - si) \right) * 2.5 \quad (1)$$

In practice, 7 experts have been provided to evaluate by using the SUS. The scoring of the importance levels of the heuristics stated in Table 2 has been made out on the 5-point Likert scale. By emphasizing the degree of importance in the scoring, it has ensured that the heuristics that needed to be solved first have been determined. The site map in Figure-2 has been shared with experts so that the menus of the heuristics where the problems are identified can be easily seen. In Table 3, the evaluation of the system usability scale has been made over 100 points, and the SUS score is obtained. In line with the results obtained as a result of the scoring of the seven experts, the heuristics that the experts had different opinions have been examined.

3. RESULTS

In the study conducted by Brooke (1996), it was stated that when an evaluation is made with 5 experts, it would reach 75% of usability problems. In this study, the heuristic assessment and the SUS were applied to a group of 7 experts consisting of 6 men and 1 woman, aged between 25 and 45. The computer skills of the experts are at an ultimate level and their field knowledge experiences appear in the academic and private sectors. Experts made their examinations on mobile devices running the Android operating system.

3.1. Heuristic Evaluation Results

Findings obtained by taking expert opinions are summarized by considering Nielsen's heuristic titles in Table 1 [11].

Visibility of system status: Stated by experts that the visibility of the system status is sufficient, there is no delay on the screens, and sufficient information is provided to the user.

Matching between system and the real world: In general, experts claim that "*The language used in the application is simple and clear, the symbols used are associated with actions, the language for the last user is simple and understandable, and the system is related to the real world."* An expert stated that a technical error message was given on the error screen, unlike the error codes that were meaningful to software developers it was not purposeful to the last user.

User control and freedom: For user control, all experts gave negative feedback. All experts, *"It can not be entered on the settings page with the back button. A button to revert this status when the alarm button is accidentally pressed, etc. is not available. But if the earthquake button is pressed again, the button becomes passive or while you can exit the share location menu with a cross, this is not available in other menus."* stated their negative judgments. Another expert on this situation, *"A notification of accidental pressing may be received from the user within 30 seconds."* By offering a solution proposal in the form of a solution, the user was informed about the possibilities to be provided for control and independence.

Consistency and standards: On consistency and standards, experts gave different opinions. It was observed that three experts found the rules appropriate. On the other hand, it is seen that giving access to the same page from more than one screen is shown as an inconsistency. All experts also stated that the correct symbols are used in terms of the standard.

Error prevention: An expert states that error prevention mechanisms should be checked as*"Despite the registration by requesting subscription information during registration to the system, requesting confirmation from the user again after registration creates a problem in terms of error prevention"* Another expert stated that the "*User ID can not be 0*" message received after entering the TR ID number on the subscription information screen is a technical error and that this error should be prevented.

Recognition rather than recall: There is a dominant opinion that expressions that require sufficient recognition but are not recalled are used in the mobile application. However; *"The information about application usage in the help menu is not sufficient." opinion stated by 3 experts.*

Flexibility and efficiency of use: Six experts stated that the application was sufficient in terms of flexibility. Besides an expert is to provide flexibility to the last user in a better way, menu etc. stated that it would be beneficial for the screens to be customizable.

Aesthetic and minimalist design: As the design and content are compatible, it has been stated by the experts that the application looks aesthetically pleasing. It has been stated that

conspicuous components such as the "Panic Button" are positioned correctly, and similar screens or tools can be enriched.

Recognize, diagnose, and recover from errors: The general opinion of the experts on error recognition is positive. However, it has been stated that the error with the message "User ID cannot be 0" after entering the TR ID number does not give the user sufficient information about the diagnosis.

Help and documentation: It was criticized negatively by all experts. It was stated that the content of the help menu is complex and needs improvement. It was stated that it would be beneficial to enrich the content of the frequently asked questions menu.

Table 2. Obtaining expert opinions – Scoring the importance of heuristics

Expert Number Heuristic Assessment Headline	E1	E2	E3	E4	E5	E6	E7	IMPORTANCE SCORE
Q1-Visibility of system status	5	5	3	3	4	3	5	4,00
Q2-Matching between system and the real world	5	4	5	5	5	5	5	4,86
Q3-User control and freedom	1	4	5	5	5	5	1	3,71
Q4-Consistency and standards	5	3	5	5	5	4	2	4,14
Q5-Error prevention	4	4	1	5	1	1	2	2,57
Q6-Recognition rather than recall	5	5	4	4	4	3	5	4,29
Q7-Flexibility and efficiency of use	5	4	2	2	3	2	5	3,29
Q8-Aesthetic and minimalist design	5	5	5	5	5	5	4	4,86
Q9-Recognize, diagnose, and recover from errors	4	5	4	4	4	4	3	4,00
Q10-Help and documentation	3	4	4	4	4	4	3	3,71

In the evaluations of the experts, the error prevention heuristic should be resolved in the first place with 2.57 points. 3 out of 5 experts reported that screen designs should be enriched to prevent the user from making mistakes. This is the first issue that software developers should review from the point of view of the “Error Prevention” heuristic. Help and documentation, user control and independence heuristics both scored 3.71, with negative feedback from all experts. It has been stated that the "Frequently Asked Questions" section shown on the site map has been criticized by experts and should be improved. It was seen that the average score of 3.94 (78.8 out of 100) obtained from the evaluations of the Panic Button application was sufficient [24].

3.2. System Usability Scale Results

Table 3 shows the distribution of the scores given by the 7 experts who evaluated the application to the 10 questions in the system usable scale.

Table 3. Expert Evaluations with System Usability Scale

Expert Number	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS SCORE
E1	4	2	5	1	3	2	4	2	5	2	80
E2	3	1	4	2	5	3	4	1	3	5	67,5
E3	4	2	4	1	4	2	4	2	5	1	82,5
E4	3	1	5	1	4	1	5	1	4	1	90
E5	4	2	4	2	4	1	3	1	5	1	82,5
E6	4	2	4	1	4	1	4	1	5	1	87,5
E7	2	1	5	1	4	1	5	1	1	1	80

As can be seen in Table 3, the highest SUS score obtained is 90, and the lowest SUS score is 67.5. A score of 82.5 appears like the peak value (mode) given by more than one expert. Overall,

the average score of the evaluation by 7 experts is 81.16. This average score was found in the Bangor et al. (2008) scale that corresponds to the “B” grade. An average score of 81.16 from expert reviews indicates that users can have a good usability experience. According to Sauro(2011), another evaluation study, it states that 68 points are an average score in the SUS evaluation. When the app's 81.16 scores are compared with Sauro (2011)'s average score, it shows that the usability level of the Panic Button application is well developed [25, 26]. While it is seen that the scores given to the experts in all heuristic evaluations between Q1 and Q8 are close to each other, the scores given to the 9th and 10th questions of the scale difference between the two experts, even though the scores given by E2 and E7 do not pose a problem in terms of the SUS score.

It was seen that the scores given by the experts to all questions in the heuristic evaluation were close to each other. This supports the fact that experts have a similar view on the usability of the application.

4. CONCLUSION AND DISCUSSION

It is recommended by experts to improve the application by making the necessary updates regarding the negative situations in heuristic evaluations. In the future, continuous improvement of the mobile-based interface can improve the user experience. Moreover, it is predicted that the use of different mobile operating systems (Android, iOS, etc.) in the evaluation phase of mobile usability may contribute to the solution of more problems. In the literature, usability evaluation is made using either Nielsen's heuristics or SUS, but in this study, both methods were used hybridity together and evaluated by experts and more consistent results were obtained.

Our experts, emphasizing the importance of time for emergency notifications given within the scope of the study, also stated that the user needs quick access with a few clicks. In this context, as a result of our research, it is recommended to consider the following items in the development and evaluation of emergency mobile applications.

- Using Widget in Emergency Applications
- Application Responding in a Certain Time
- Reporting the Location Information Accurately and Swiftly to the Other Party

Nielsen heuristics are used extensively throughout the topics where usability evaluation is made [11], but they cannot fully satisfy the special needs of software types that require special work (mobile device applications). In the usability evaluation of software types that require special work such as mobile device applications, heuristic development studies specific to usability problems are carried out in very few studies [7,25-26]. With the increase of these studies, the usability problems that need to be evaluated within the software serving special subjects will swell. In this case, it reveals the need that new heuristic evaluation methods can also be developed.

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