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A Study on Usability Improvement of Mobile Healthcare Services

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Abstract

The developments in mobile technology and the increase in the production of smartphones have led to the growth of the mobile healthcare market. Moreover, the number of mobile healthcare apps is on the rise, and users are benefiting from using healthcare, exercise tracking, and body monitoring apps, as well as they have been searching for health information through mobile health apps. This paper evaluated the usability of a symptom checker application that provides information on diseases, treatment methods, and related hospitals through self-diagnosis of symptoms. Symptom checkers are currently being developed, and are widely used overseas. This paper sought to evaluate the usability of a symptom checker app, and suggested ways to introduce enhancements.

Key words: *Usability improvement, Mobile healthcare, Symptom checker app.*

1. Introduction

The growth rate of smartphones is most evident in the mobile device market, and it is expected to continue expanding in the future. The rise in smartphone usage has led to an increase in the number of mobile-based applications. As smartphone use spreads and access to wireless Internet increases, medical information services have started turning to the mobile-based environment. Particularly, the number of apps is rising sharply. Since it is possible to gather and monitor the users' health information through mobile apps and sensors installed on smartphones, personalized healthcare services are expected to become widely available [1].

However, mobile applications for healthcare services have various limitations compared to the PC environment. This is mainly due to certain constraints, such as the limited screen size of the mobile device, difficulty of input, and slow Internet speed. Therefore, it is necessary to conduct a study regarding the construction of medical information services that are suitable for mobile devices. Specifically, there is a lack of research on the usability of the interface that can promote the use of mobile applications in providing healthcare services. In this regard, this study seeks to analyze the problems through evaluating the usability of a mobile application that provides healthcare services, and suggests enhancements in mobile healthcare applications based on the results.

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The areas in mobile healthcare applications are divided into behavior tracking, body monitoring, diet, weight loss, and provision of health information. This paper seeks to evaluate the usability of a symptom checker application that can identify the name of the disease, treatment methods, risks, and related hospitals once the user enters his or her symptom. Symptom checker programs were developed by Drugs.com of Harvard Medical School, WebMD, iTrage, Symptomate, and Symptom Checker, and have been widely used overseas, though their applications are rare in Korea. This paper evaluates the usability of overseas mobile symptom checkers, which are commonly used at present, and presents its suggestions toward improving their services.

Chapter 2 describes the types of mobile symptom checker applications, while Chapter 3 presents usability evaluation methods. Chapter 4 analyzes the results of the usability tests, and offers proposals toward enhancing the functions of mobile symptom checkers. Finally, Chapter 5 draws conclusions.

2. Symptom Checker Applications

2.1 WebMD [2]

The WebMD symptom checker application provides available medical information on symptoms that a user has selected or entered. Figure 1 shows the user interface of WebMD. The user must enter his or her age, gender, and zip code (optional) to start the application. An image of the human body is presented based on the gender entered by the user. Once the user selects a region that is in pain through touch, a list of more detailed symptoms will appear. When the user selects one among the detailed list of symptoms, a list of questions will be provided to define the symptoms more clearly. Answers to the questions will be recorded through the check marks on the list. After the user has answered all the questions, a list of diseases corresponding to the symptoms will be displayed. If the user selects a specific type of disease, he or she will be provided with information on the overview of the disease, how common the disease is, possible treatment methods, when to see a doctor, how to go about self-care, and risk factors.

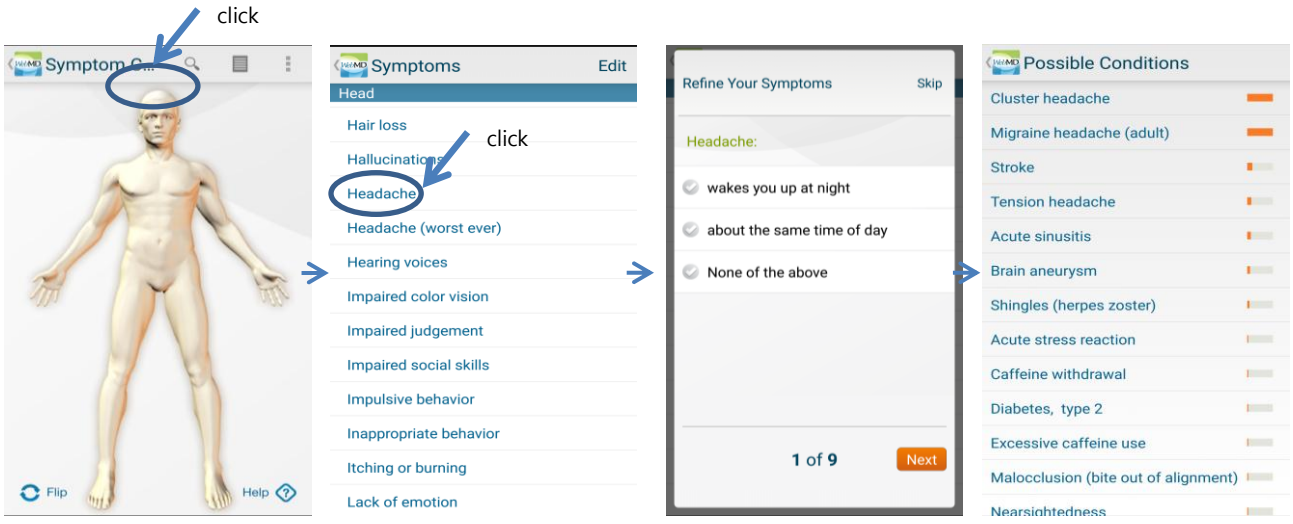

Figure 1. User interface of WebMD

2.2 Drugs.com [3]

Drugs.com has an interface that is similar to WebMD. Figure 2 shows the user interface of Drugs.com. An avatar of the human body is presented, and the user can select the body part that is in pain. First, the user selects if he or she is a man, a woman, or a child. Next, when he or she selects the painful part, a list of

symptoms will appear. Once the user selects one of the symptoms, further questions will be presented. When he or she finishes answering the questions, diagnostic results will be displayed.

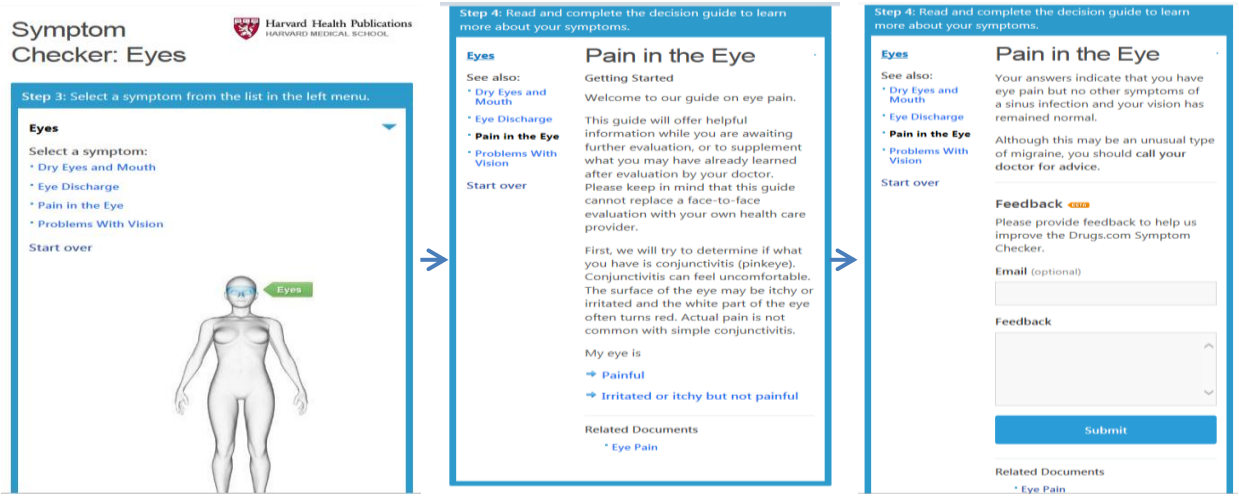

Figure 2. User interface of Drugs.com

2.3 iTriage [4]

iTriage also provides an avatar of the human body. Figure 3 shows the user interface of iTriage. When the user selects a symptomatic region, a list of symptoms will appear. After the user selects one of the symptoms, he or she will be asked to enter gender, age, and additional information. At the end of the entry, information on the status of a possible disease will be provided along with the information on treatment methods, healthcare providers, tests for diagnosis and treatment, and images and video information related to the disease.

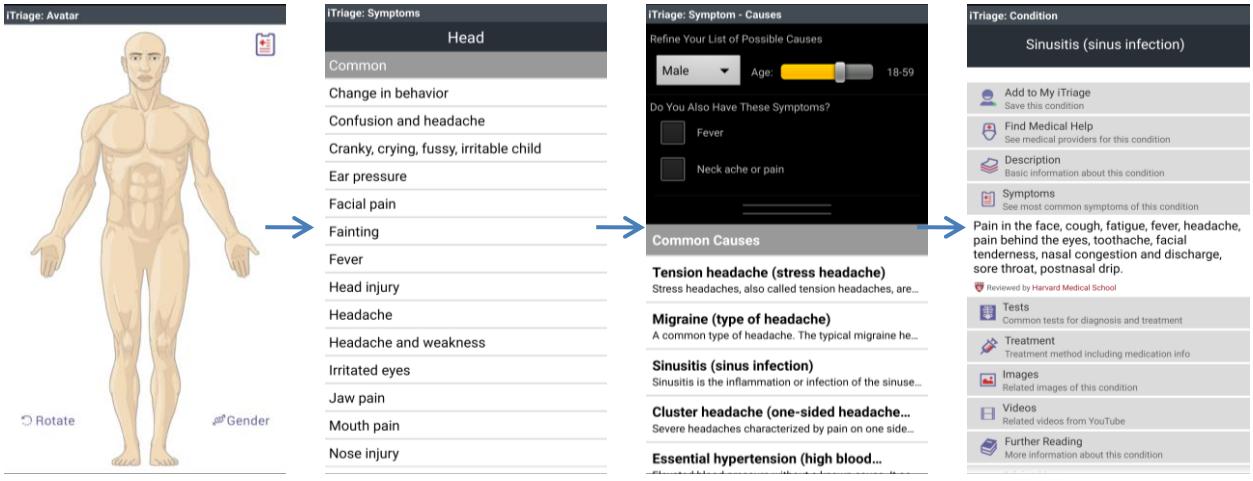

Figure 3. User interface of iTriage

2.4 Isabel Symptom Checker [5]

Isabel Symptom Checker provides a free text field. Figure 4 shows the user interface of Isabel Symptom Checker. The user enters his or her gender, age, and location on the first screen of the application. Then, the user should enter his or her symptoms on the free text field in the form of texts. If the user types ‘hea’ in the course of typing ‘headaches’, a list of various symptoms that start with ‘hea’ will appear. If the user selects

headaches, possible diagnoses will be displayed. If he or she selects one of them, websites and YouTube videos that can show available information will be provided.

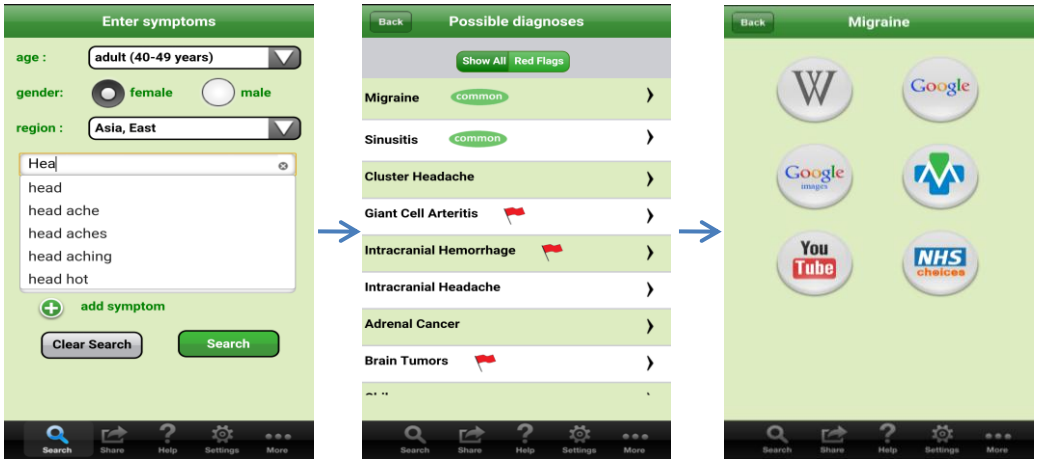

Figure 4. User interface of Isabel Symptom Checker

2.5 Symptomate [6]

The user enters his or her gender, age, height, and weight on the initial screen, and selects his or her symptom from the symptom list. Figure 4 shows the user interface of Symptomate. In relation to the symptoms, risk factors, such as hypertension and diabetes, are then selected. If the user selects the location in which he or she lives, and answers the questions related to his or her symptoms, the results related to the symptom will be displayed at the end. The selection of a full article will lead to links to Wikipedia with the relevant information.

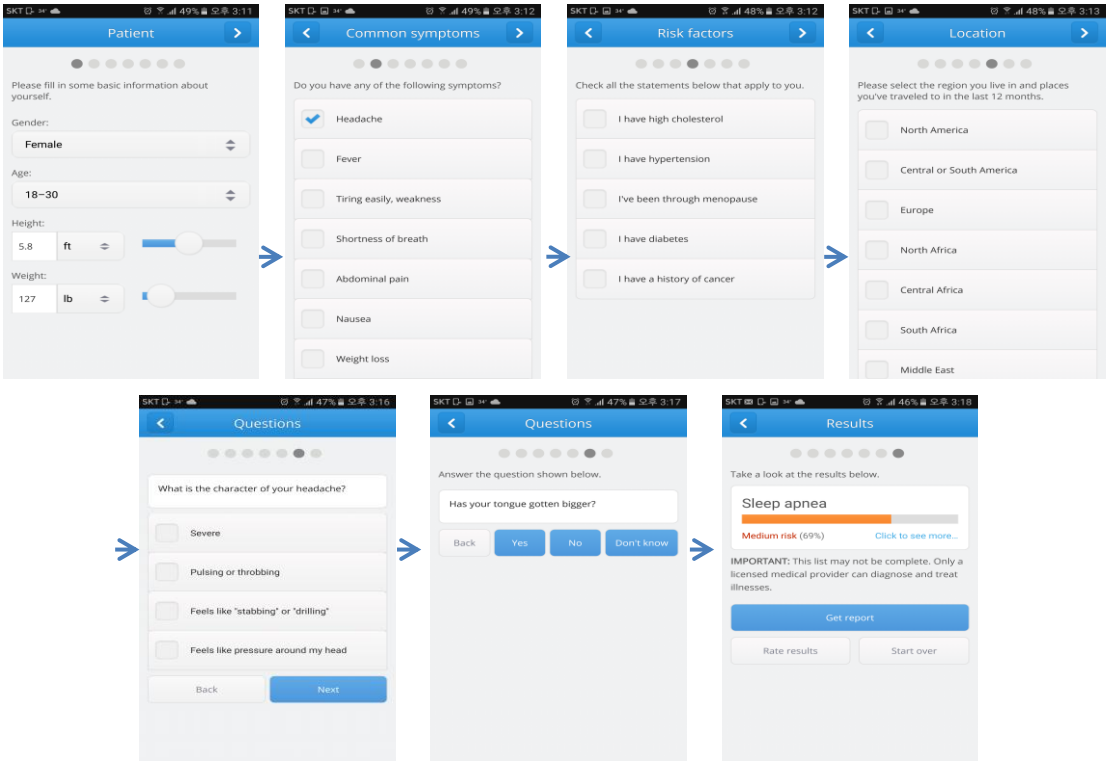

Figure 4. User interface of Isabel Symptomate

2.6 Symptom Checker [7]

In the initial screen, the user can search for symptoms by body region, disease category, list of diseases, and demographics. Figure 5 shows the user interface of Symptomate. There is also a function that allows the user to enter symptoms directly, as well as enter symptoms by voice. If the user directly enters the body part that is in pain or the symptoms, more questions will begin to appear. At the end of the questions, possible information on a disease related to the symptoms will be displayed, and the user will be guided to the nearest emergency room in case prompt medical attention is necessary.

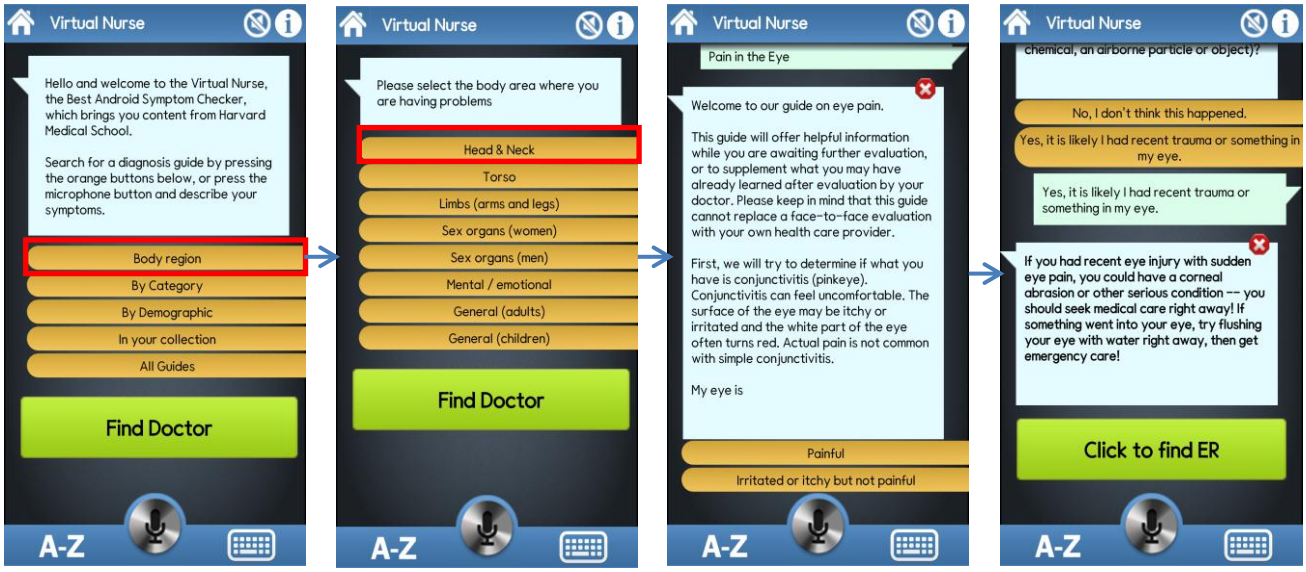

Figure 5. User interface of Symptom Checker

3. The Method of Evaluating the Usability of a Symptom Checker App

The purpose of the symptom checker is to help users detect possible diseases for their symptoms easily and quickly, and to provide them with information on treatment methods, hospitals, and risk levels. The usability evaluation was conducted with the mobile symptom checker application that was introduced in Chapter 2. The evaluation was based on the considerations in the production of the mobile app and Jacob Nielsen's usability principles. The usability principles defined by Jacob Nielsen include learnability, efficiency, memorability, errors, and satisfaction. Learnability signifies how quickly a new user can learn the system to complete basic tasks. It can be evaluated by measuring the time that it takes first-time users to navigate the UI and perform tasks. Efficiency means that the system should be useful enough for experienced users who already know how to use the system in performing a higher level of task. It can be evaluated by measuring the time that it takes users who have already learned to use the system in completing high-level tasks. Memorability means that the system should be easy to remember so that even a user who has not fully mastered the system, or has not used it for long periods of time can readily use it again. Errors mean that the error rate should be low while the system is in use, and the system should be easily recovered even if mistakes are made. The system error rate is calculated by measuring the number of errors that occur during user operations. Satisfaction means that users can use the system to their satisfaction. The level of subjective satisfaction can be measured by asking users for their opinions. If a tremendous overlap between the views on system satisfaction is derived, it can be an objective measure of the level of satisfaction. The usability

items that should be considered in a mobile environment, compared to a desktop environment, include a smaller screen, an inconvenient input method, and slow downloads [8]. Based on these studies, this paper evaluated learnability, user interaction, and readability of the mobile symptom checker. Table 1 shows a summary of the usability evaluation factors and related items.

There are three types of user interfaces that select symptoms in the symptom checker apps. WebMD, Drugs.com, and iTriage provide images of the human body so that users can select the specific body part in pain. Isabel Symptom Checker and Symptomate are designed to enter symptoms in the form of text. Symptom checkers present a list of symptoms by body region, category, and gender, and allow users to select their symptoms.

Table 1. Usability evaluation factors and the items of the symptom checker app

Evaluation factors	*Usability evaluation items*
User interaction	The number of input errors that occurred while searching for information on the symptoms after running the app
	Is it easy to move from the current location to the previous/high-order page?
	Is it possible to select a symptomatic region in the image of the human body one at a time?
	Is the user's input minimized when the user's basic personal information (age, height, weight, etc.) or text is entered?
	Is user interaction done smoothly without zooming in/zooming out?
	Is the overall level of satisfaction with user interaction high?
Learnability	Can users quickly figure out what actions they must take to enter symptoms on the first screen of their apps?
	Is the method of retrieving information on the symptoms convenient and satisfactory?
	Is it easy to find key features, such as how to search for symptoms, search box, and user information input on the initial screen?
	The number of incorrect menu accesses and selections until users obtain a list of possible diseases and information based on their symptoms
Readability of information	Do users need to use the zoom in/out feature separately to enter symptoms and read information?
	Are the list of diseases and detailed pages on relevant information structurally simple and well-organized?
	Are the font type, size, and color of text suitable for users to recognize information?

4. Analysis of the Evaluation of Symptom Checker App Usability

For the six symptom checker apps that were investigated in Chapter 2, a usability evaluation was performed with respect to the evaluation items defined in Chapter 3. Five people were selected as evaluators to proceed with a heuristic evaluation. The five evaluators have more than 15 years of work and research experience in mobile, Internet, and multimedia-related industries. They were asked to examine the evaluation

items on a 5-point scale while performing two tasks. The tasks performed by the evaluators are as follows.

Task 1) Run each of the symptom checker apps and perform a process to search for information on possible diseases related to dizziness symptoms

Task 2) Run each of the symptom checker apps and perform a process to search for information on possible diseases related to eye irritation or itchy eye symptoms.

4.1 Usability analysis of the symptom checker app

4.1.1 Analysis of user interaction

Table 2 shows the results of the evaluation of user interaction. The overall level of satisfaction with user interaction is highest in iTriage, followed by Drugs.com, and WebMD. Symptom Checker exhibited the lowest level of satisfaction. The method of selecting the part where the symptom appears demonstrated the highest level of satisfaction, followed by the method of searching for symptoms by entering texts, and the method of selecting from a list.

Table 2. Results of the evaluation of user interaction

Evaluation factors	Web MD	Isabel Symptom	Drugs.com	Symptommate	iTriage	SymptomChecker
The number of input errors that occurred while searching for information on the symptoms after running the app	0.3	0.4	0.1	1.5	0.7	0.8
Is it easy to move from the current location to the previous/high-order page?	4.9	4	4.6	5	4.5	4.4
Is the user's input minimized when the user's basic personal information (age, height, weight, etc.) or text is entered?	4.7	3.3	4.6	4.4	4.8	3.9
Is user interaction done smoothly without zooming in/zooming out?	3.4	4.2	4.1	4	4.3	4.3
Is the overall level of satisfaction with user interaction high?	4	3.5	4.1	3.6	4.3	3.3
Is it possible to select a symptomatic region in the image of the human body one at a time?	3.3	-	4.1	-	4.7	-

Isabel Symptom Checker got the lowest score in evaluating whether user input is minimized when the user's basic information through texts are entered. Isabel Symptom Checker proved inconvenient because a user must press the "set" button when selecting age in the Select list. The same was true for the selection of location. Since the minimization of selection and input is a means of improving usability, the duplicate selection that is checked after initial selection must be removed.

The results of the evaluation on user interaction without the use of the zoom in/zoom out feature showed that WebMD obtained a low score, and it even got the lowest score in the evaluation of whether a symptomatic region in the image of the human body can be selected one at a time. The selection areas of WebMD, Drugs.com, and iTriage, which provide images of the human body, were compared. iTriage does not subdivide the selection area, and is designed to show all symptoms, including those affecting the eyes, nose, mouth, and ears when the head area is selected. Drugs.com allows a user to select the head and neck area, eye area, and ear/nose/throat areas. In the case of WebMD, the selection area is subdivided into eyes/nose/mouth/ears/cheek/jaw in the facial part of the image of the human body.

It is not easy to select the subdivided section area on a small screen of a smartphone at a time. To select eyes in WebMD, a user has no choice but to use the zoom in/zoom out feature, and it is not easy to select them at once. The evaluation, therefore, found that the selection of the subdivided area causes inconvenience to the user in terms of usability.

4.1.2. Analysis on learnability

Table 3 shows the results of the evaluation pertaining to learnability. We evaluated how well a new user can perform a search for basic symptoms even if he or she does not know how to use the system.

Table 3. Analysis on learnability

Evaluation factors	Web MD	Isabel Symptom	Drugs.com	Symptommate	iTriage	SymptomChecker
Can users quickly figure out what actions they must take to enter symptoms on the first screen of their apps?	4.5	3.7	4.2	3.6	4.4	3.7
Is the method of retrieving information on the symptoms convenient and satisfactory?	4	3.2	4.3	3.5	3.8	3.1
Is it easy to find key features, such as how to search for symptoms, search box, and user information input on the initial screen?	4.4	3.6	4.3	3.8	4.3	3.3
The number of incorrect menu accesses and selections until users obtain a list of possible diseases and information based on their symptoms	0.9	0.2	0.4	1.3	0.5	2.2

The image-providing types, such as WebMD, Drugs.com, and iTriage, scored high in the evaluation of what actions the users must take to enter their symptoms on the first screen. On the other hand, the text input type and the type in selecting from a list got a lower score compared to that of the image-providing types.

Even in terms of the ease in searching for information on symptoms and finding the main features, the image-providing apps scored high. The frequency of incorrect menu access until users saw a list of diseases and related information on their symptoms was highest in Symptom Checker, followed by Symptomate. Isabel Symptom Checker exhibited the lowest frequency of incorrect menu access because the symptoms were retrieved directly in the form of text.

As shown in the following figure 5, in the case of Symptom Checker, various types of lists are presented on the initial screen, therefore a user is highly likely to worry about which category they should select to search for a symptom. In the case of WebMD, it was highest in incorrect access and selection frequency among the image-providing apps. This is because the highly subdivided selection area leads to incorrect access.

4.1.3 Analysis on readability

Table 4 shows the results of the evaluation on the readability of information. All apps got scores higher than 4 in the evaluation of whether or not to use a separate zoom in/zoom out feature in entering symptoms and reading information. In the analysis of whether the list of diseases and detailed pages on relevant information are structurally simple and well-organized, Isabel Symptom Checker, Symptomate, and Symptom Checker scored low. On the other hand, WebMD, Drugs.com, and iTriage, which provide images of the human body, were rated relatively high.

Table 4. Readability of information

Evaluation factors	Web MD	Isabel Symptom	Drugs.com	Symptommate	iTriage	SymptomChecker
Do users need to use the zoom in/out feature separately to enter symptoms and read information?	4	4.4	4.3	4.4	4.5	4.2
Are the list of diseases and detailed pages on relevant information structurally simple and well-organized?	4.1	3.2	4	3.4	4.2	3.2
Are the font type, size, and color of text suitable for users to recognize information?	4.4	4.5	4.3	4	3.9	4

4.2 Directions of improved usability for symptom checker apps

The directions of the improved usability of symptom checker apps were based on the results of the usability evaluation.

Human body image UI provision: The image-providing apps showed higher user interaction and learnability than the app that does not provide an image. This suggests that in the case of the symptom checker app, it is effective to present images of the human body for ease of use across various age groups.

Improvement of selection areas in the images of the human body: The selection area in an image of the human body, which is highly subdivided, poses a difficult selection process. In the case of WebMD, it is difficult to accurately select eyes/nose/mouth/ears/cheek/jaw on a small screen without the use of a zoom feature. Therefore, it is more advantageous to show a list of diseases on the head and the entire face when the head is selected, as in iTriage.

Selection and input minimization: For text searches, a user can use text auto-complete to minimize text input. Isabel Symptom Checker was inconvenient, because a user must press “set” button when selecting age and area in the list. Thus, unnecessary input must be minimized not only in text input, but also in the selection process.

User input information maintenance: When a user returns to the previous screen to correct the initial input information, the previously entered information should be saved. It will be inconvenient to enter the information again because the screen is initialized when the user returns to the previous screen to make corrections.

Subdivision of question levels on symptoms: It is desirable to show a list of common diseases with respect to the symptoms that users initially entered, and then ask the users detailed questions about the symptoms, if necessary.

5. Conclusion

In this paper, we evaluated the usability of the symptom checker apps to inform users on related diseases, treatment methods, risks, and hospitals when they enter their symptoms. WebMD, iTrage, Drugs.com, Symptomate, and Symptom Checker, which have been widely used overseas, was evaluated based on readability, user interaction, and learnability in the mobile environment. Five experts conducted the evaluation according to the evaluation criteria while performing the proposed tasks within the symptom checker apps. It was found that the apps that generally provide images of the human body exhibit higher usability. The text search-type app was convenient because it created a query text through the auto-complete feature even if only a part of the text is entered. The UI for exploring symptoms in the categories by body region, type of disease, and demographics scored low in the evaluation of learnability and user interaction. Based on the analysis of the results of the evaluation, five improvements were emphasized to enhance the usability of the symptom checker

apps. First, the UI of the symptom checker app should provide an image of the human body while supporting the text input search in identifying symptoms. Second, the image of the human body should be assigned to the area that can be selected one at a time without the use of a zoom feature. Third, user input must be minimized not only in text search, but also in the selection process. Fourth, even if there is a need to return to the previous screen to check the initial personal information or disease search information for corrections, it must be kept uninitialized. Fifth, there is no need to perform detailed questioning on symptoms from the beginning. Instead, it is desirable to ask users detailed questions on the symptoms in stages, if necessary. It is expected that this study will serve as a guideline for the production of symptom checker apps that can be developed in the future.

Acknowledgement

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