Designing a Smartphone Interface Causing Discomfort for Awareness of Risks

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Abstract
Nowadays, more and more people access to the Internet using their smartphones; Accordingly, threats such as a malicious application and phishing scams targeting smartphones are rapidly increasing. It has been pointed out the problem that Internet users are not aware of threats; therefore, awareness of the threats is emphasized. We propose warning interfaces of smartphone that cause discomfort to the users so that they can be more aware of security risks. We have investigated factors that cause users discomfort while using smartphones, and then extracted five factors of discomfort from them. Our study introduces the prototype of the interface. Our study introduces the prototype of the warning interface. By using five factors of discomfort, we aimed to make users aware of threats and avoid the link to the harmful website while using web browser on smartphone.

Author Keywords
User Interface; Usable Security; Discomfort; Risk Awareness; Smartphone.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

Discomfort factors in smartphone use

1. Stumbling by system or network
Discomfort caused by operation delay or system downtime due to hardware malfunction or poor Internet connection status.

2. Operation trouble and difficulty seeing
Discomfort due to input and output not being performed smoothly.

3. Unintended operation or display
Discomfort due to getting unintentional results and performing intended operations.

4. Sudden changes
Discomfort due to extra demands.

5. Understanding of the application
Discomfort due to insufficient understanding or inadequate understanding regarding application use.

Introduction

Internet users are exposed to threats such as virus infection, unauthorized access, and phishing scams. These opportunities are expected to increase as smartphone use and IoT spread. The problem that users are unaware of security threats has been pointed out [1]; they do not take countermeasures. It is important that users maintain awareness to avoid security threats and risks. We have surveyed discomfort factors while using personal computers and designed risk-aware interfaces using discomfort feelings [2]. However, the spread of smartphones in recent years has been remarkable. According to "The household ICT device ownership rate of 2017" in Japan, "ownership of smartphones exceeds that of computers"; the PC rate was 72.5% and that of smartphones was 75.1%. In addition, according to the "Internet usage device by category" in 2017, 52.5% used PCs and 59.7% used smartphones; it is also smartphones exceeds PCs in 2017 [3].

Furthermore, "Attack aimed at smartphones and smartphone applications" is ranked 4th in "10 Major Security Threats 2018 [4]" in Japan. Worldwide, according to McAfee's announcement [5], the threat to mobile devices and other related things has increased sharply in the second half of 2018.

The threats of smartphone application are as follows: unauthorized and malicious applications steal important information in the device, manipulate the device illegally, and infect the Ransomware. There are many cases that malicious apps are installed, disguised as popular applications [4][5]. When a user is browsing a web site, there are deceptive sites which tries to input personal information online, and dangerous sites which are damaged by phishing and malware as well as PCs [6].

Under such circumstances, we consider assisting user awareness to avoid security threats and risks when using smartphones. This research's long-term goal is to design a smartphone interface that utilizes the "discomfort feeling" when using a smartphone. We expect that there are unique discomfort elements in smartphones due to differences in operability to computers, usage situation, etc. We find out that the discomfort factors when using smartphones are different from such factors when using computers. In addition, familiarity with operation depending on the years of use, smartphone operability, and the threat encountered by the differences in OS may affect the discomfort feeling when using smartphones.

This paper reports the result from a user survey on discomfort factors when using smartphones and compares that with when using computers. In addition, we describe a prototype of the smartphone interface that was implemented for smartphone browsing.

Related Work

When a user is going to execute erroneous operations, the system would display a warning message window and ask the user to answer "Yes" or "No" to proceed. However, the problem is that users tend to answer "Yes", without fully understanding the warning message.

An interface causing discomfort would raise the user's attention when a warning message is displayed on a computer. For example, some users choose "Yes" without reading warning messages about expired server certification. We believe that we can raise the

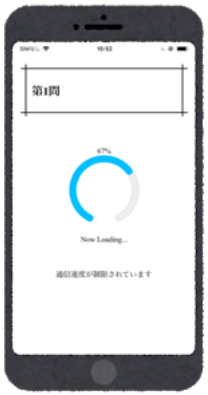

Figure 1. This is the prototype of "Stumbling by system or network" factor.

user's attention to the warning message by applying discomfort interface principles to the design of the warning. Sankarapandian et al. [7] suggested an interface to make the user aware about the vulnerabilities posed by unpatched software. They implemented a desktop with annoying graffiti that showed the number and seriousness of vulnerabilities. Egelman et al. [8] conducted an experiment on the rate to avoid the damage caused by phishing; the Human Information Processing) model [9] in which the interface warns users about vulnerabilities. They reported that the user responses to a warning differed depending on the type of interface used.

For harmful pages such as phishing sites and malware distribution sites, warnings are displayed in browsing applications such as Google Chrome and Firefox [10], and so on. In the case of Google Chrome for Android, when a user access unsafe sites with Safe Browsing[11] is enabled, a warning page explaining that there is a possibility that dangerous contents may be included (Figure 1). Also, on the Google search result screen, when a site that is not secure is listed in the search result, a warning is displayed next to the site [12].

Security applications also display a warning to a site that is not safe. In the case of Virus Buster Mobile [13] from Trend Micro, it displays a warning page like Google Chrome or a pop-up picture with warning message when tapping a link to the site (Figure 1). They provides protection against threats in in-app browsers. It is also applied to the browser in several applications.

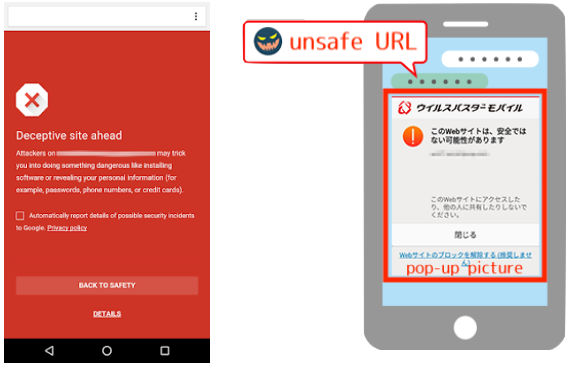

Figure 2: Warning When a User Access Unsafe Sites. (left) Warning Page, Google Chrome[14], (right) Image of Warning Pop-up Screen on Messenger Application.

Implementation of a Prototype of a Smartphone Interface

The purpose of a smartphone interface causing discomfort is to help the user become aware of security threats; however, this interface needs to be designed in a manner that does not discourage a user from using the interface. We have considered the warning interface of a Web browser that is displayed when a link to a harmful site is detected, and implemented a prototype of such a warning interface. We have developed Web page action using JavaScript. The following five discomfort factors might be used in such an interface.

Factor 1) Stumbling by system or network

We can conceive of creating interfaces that make users feel caught with factors other than applications such as operation delays or temporary network shutdowns. If user try to tap a link that is unsafe, the user will see the page telling that connection is delayed due to speed limit (Figure 2).

Figure 3. This is the prototype of "Operation trouble and difficulty in seeing" factor.

Figure 4. This is the prototype of "Unintended operation or display" factor.

Factor 2) Operation trouble and difficulty in seeing
We can conceive of creating interfaces such as operation range expansion, increasing the number of operations or inputs, and scaling characters more than usual. This interface makes user difficult to tap the link to the unsafe site by displaying letters in tiny font size; which takes time and effort to enlarge the character using two fingers (Figure 3).

Factor 3) Unintended operation or display
This interface has the button which runs away when users try to tap. It cannot be easily tapped even if users make a great effort (Figure 4).

Factor 4) Sudden changes
This factor indicates that some changes are occurring to the page. Tapping the link to unsafe site causes short vibration. The vibration time was set to be longer according to the number of taps.

Factor 5) Understanding the application
This factor indicates by placing buttons in a difficult position to find or understanding of the application is difficult. Therefore, when the user tap unsafe site, another application starts up.

Conclusion

We conducted a questionnaire survey on user subjectivity and examined the discomfort factors for smartphones from the analysis. As this paper reports, prototype of the smartphone interfaces for smartphone browsing were implemented for each of the five factors obtained as a result of the survey.

In future work, we need to verify user discomfort and the effects on awareness using the implemented interface. Differentiation from the existing warning interfaces and familiarization problems are also future tasks.

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