Comparison between Significance of Usability and Security in HCI

[1]Harshul Garg, [2]Tanupriya Choudhury, [3]Praveen Kumar, [4]Sai Sabitha
Computer Science and Engineering Department
Amity University, Uttar Pradesh
Noida – India
[1]harshgarg97@gmail.com,[2]tchoudhury@amity.edu,[3]pkumar3@amity.edu,[4]assabitha@amity.edu

Abstract: **Technology pertaining to Human Computer Interaction has seen vast leaps of advancements in recent years. And so, have the hardware using those technologies. But Despite all of these advancements, users are often left disappointed. The major cause of this disappointment is mostly either of lack of usability or lack of security or sometimes both of them. This paper discusses the problem of balance between usability and security as these two are the most significant challenges in the area of HCISec. Significance of both security and usability is discussed in this paper in order to find the more dominating aspect in the design of human computer interaction systems. Also, a case study on usability and security is presented on the iOS and Android operating systems to get a clear idea of the significance of both the factors. In the end, a conclusion is reached highlighting the importance of both usability and security.**

Keywords-Security; Usability; HCISec; Evaluation; HCI

I. INTRODUCTION

Since the advent of computers, Human Computer Interaction technology has come a long way. The systems have turned from targeting specific audience to mass audience, from unimodal to multimodal systems [1] and from static to active systems. All of this resulted in continuous upgradation of the technologies prevalent in HCI and continuous improvement. While designing HCI systems, it is often difficult to decide what to base our design upon: Usability or Security. HCI deals basically with the usability part of the field. Security matters generally come under HCISec (Human Computer Interaction) which may be considered a subfield of HCI. These terminologies are further discussed in the next section. But for now, we can understand usability as ease of use and security as protection from unwanted problems. So do we really need to base our designs upon usability or security or can we make do without any of them? This question can be answered by asking another question to ourselves i.e. what do we, as humans need in computer systems? Most of us would surely answer in terms of ease of use, simplicity, aesthetic user interface, secure, authentic and genuine. So this asserts the point that both usability and security are very necessary to keep in mind. But which one to what extent? This is what we will try to answer during the course of this paper. Also, the question of interfacing has always hogged the limelight. As useful as computers are, bad interfacing always dulls the interaction between the humans and the system due to which the usefulness of the system decreases drastically.

II. TERMINOLOGIES

Before delving into specifications, we need to understand the terminologies that we will be using. Human computer Interaction (HCI) is the field of computer science which focuses on the interfaces between humans and computers. It is concerned with the way humans interact with computers and how the computers provide the user with a good experience. Researches in the field of HCI generally focus on usability i.e. work is done mostly on improving the experience of the user interface. According to Shneiderman [2], "usability of a system with a certain functionality is the range and degree by which the system can be used efficiently and adequately to accomplish certain goals for certain users". When we talk about usability, we ignore the security issues of the system. After all, what does security have to do with an aesthetic system design. According to ISO, Usability consists of Effectiveness, efficiency and satisfaction which have been tried to use as measure of usability in the past without leading to concrete results. But as the number of people and businesses shifting their chores onto the computers are increasing, the need for a usable system with security is becoming indispensable. [3] Usability evaluations of secure HCI systems require methodologies that deviate from the techniques in HCI. This gave rise to HCISec (Human Computer Interaction). This field focuses on designing and creating systems with usable security so as to offer the users with complete experience without worrying about security. We asked the question," What is more important: Usability or Security?". By discussing the terminologies, we are starting to get the idea that both are important, that we can't go about designing HCI systems without either of them. But which is more important, ease of use or security?

III. USABILITY SIGNIFICANCE

Although we discussed a definition of usability above, we didn't get a look at its importance. When designing computer systems, the target audience is kept in mind and the system is designed accordingly. The age and experience of the user using the system varies significantly. In late 90's, when systems were beginning to be mass produced the target audience base was very less. People were new to the concept of using computer systems in their daily life for their daily

chores. At that time usability was not that important as people were open to learning and due to lack of options they had no choice but to get familiar with the workings of the system. But as the technology grew and competitors producing computer systems increased, usability took on a more important role as people started flocking to more easy-to-use systems for their tasks. Also, age was a significant factor in promoting usability. Children and old people had a hard time learning the ins and the outs of a basic computer system and so usability had to be kept in mind while designing those computers. [4] N tractinsky in his paper said that psychological aspect of humans leads them to associate usability with beauty. The more beautiful the system is, more usable it seems. He took an ATM (automated teller machine) and tested his research. The results clearly indicated that aesthetics clearly affect the usability in human mind. Also, Jordan (1998), Norman (1988) et al point out in their paper that earlier products ranging from photocopiers, VCRs and cookers were designed with little regard for the people who would be using them. This absence of usability led to irritations, frustration, time wasting and disappointments among the users. Although these products are not entirely software based, they do come under human computer interaction and therefore serve the purpose of research. The major problem is the lack of any existing usability measures. Although ISO [5], in its definition of usability does mention three aspects:

• *Effectiveness, is the accurateness and the level of completeness which is required to achieve specific goals. Metrics of effectiveness include the solution quality and the rate at which errors occur.*

• *Efficiency, is the relation between accuracy and completeness of the system. Also, efficiency is measured in terms of the resources expended in achieving the certain goals. Metrics of efficiency consist of time taken to complete the task and the learning time.*

• *Satisfaction, is the users comfort level in using the system and the attitude towards the final product. If a person is happy with the product, he is said to be satisfied. There are various scales and charts to measure human satisfaction. [6] SUMI is one of such scale.*

However, these 3 terms are themselves kind of unmeasurable. Therefore, usability measurement is a difficult task. Also, the correlation between effectiveness, efficiency and satisfaction is not well understood. Erik Frekjmr, Morten Hertzum and Kasper Hornbmk in their paper [7] undertook a research involving analysing the data from a study of information retrieval and found only a weak correlation between the three aspects.

IV. SECURITY SIGNIFICANCE

The main aim of information security is to provide confidentiality, integrity and availability. These 3 aims are equally applicable to the field of HCI Security. When using a computer system, a common user is generally not concerned with security issues. But as the number of daily chores shifting on to the computers increased, so did security concerns.

Human computer interaction continues to change the world in the respect any task is performed. More and more people are shifting on to the computer systems to perform their chores which makes the threat to security an even more important aspect. Loss of various commercial openings, decline in existing business, decline in credibility, lagging behind the competitors are some of the results if security gets void. Human computer interaction systems compromise of biometrics and cryptography as an important part for authentication and access. Security in these components become indispensable. To design a safe and secure computer system one needs to take care of the following things during the development phases of the system: -

• *Requirements-* Defining security measures at early stages like requirements can be very useful and can make it easier to identify important milestones. At this level, acceptable levels of security measures can be defined which can help to identify the risks associated with the system design.

• *Design-* When designing systems, we need to consider many things to make them secure without compromising on the security. For example, when designing the interface of a video game it is a good habit to list all the settings in one place rather than divided in various corners so that the user may not miss out on important settings that could compromise the security or the performance of the system.

• *Development-* Security can be incorporated into the development phase by using tools that are regularly updated. Keeping the development team updated about these tools can help to enforce security practices. Another method to ensure the security by analysing the APIs used by the system and avoiding those that have been deprecated or declared unsafe to use. Above all, reviewing the system before deployment can ensure that all the security practices have been followed.

• *Deployment-* During this phase runtime verification checks can be performed. At this stage the system should be monitored for various security issues like user-access, data access or corruption. At this stage, a random and potentially harmful input can be given to the system to be sure that system is secure before it is released for public use.

• *Maintenance-* At this stage, since the system has been deployed and is accessible to end users, this stage should enable the developers of the system to help and protect the users from security and privacy issues that may arise.

Therefore, we have seen that security is as important as usability when designing HCI systems and that special guidelines have to be kept in mind in all phases of development of the system so as to conform to the objective

of producing safe, secure product that also meets the usability criteria.

V. RELATED WORKS

Yee [10] in his paper "*Aligning Security and Usability*" said that both usability and security are important for designing hci systems and that while designing the systems, user requirements and expectations be kept in mind and authorization to those systems be provided on the basis of their designations i.e. an iterative combination of both usability and security.

[8] D. Balfanz, G. Durfee, D. Smetters, and R. Grinter, in their paper, "*In search of usable security: five lessons from the field*" said that users either misunderstand the security implications of their actions, or they consciously turn off security features to "fix" usability problems. Therefore, systems must be designed which are simultaneously both secure as well as usable.

Adams [9] in "*Users are not the enemy*" said that insufficient communication with users produces a lack of user-centred design in security mechanisms.

"*Computer Security: Anatomy of a Usability Disaster, and a Plan for Recovery*" by M. Angela Sasse [11] reviewed the past and current works on usability of security mechanisms. Also, it provided new research challenges in the field of usable security.

Shneiderman [2], gave the definitions of functionality and usability in his paper "*Designing the User Interface: Strategies for Effective Human-Computer Interaction*"

VI. CASE STUDY

To get a more practical idea of the usability and security significance we will undertake a case study. We will compare two of the most successful mobile operating systems: iOS and Android in terms of usability and security. We will undertake the following tests:

Usability tests: -

For this, we will use an **A/B test**. In this user is presented with either image A or image B but not both to see how the user interacts when alone. When looking at the results we get a fair comparison between A and B, and thus have a fair idea of how the two different designs or interfaces compare. [12] said that "It's easy to judge which interface is the winner if it takes users a lot longer to interact with one than the other, or if they frequently select the wrong location or button for a simple task".

A **Preference test** is the one which tests the preference of one platform over the other for the user for particular applications. In this test, there are two designs or application interfaces presented to the user side by side. One look at the result and it will be clear which interface or design users favor the most.

Security Testing: -

Security testing will be done with the following factors kept in mind: - Provenance, permission based access control, encryption technique and isolation. Both android and iOS were tested and then results were formulated.

VII. RESULTS

Table 1:Android vs iOS usability results [12]

Application	Function	Winner
Twitter	View Tweets	Draw
Google Translate	Changing Language	Draw
	Audio pronunciation	Android
Sound hound	Song Sharing	Android
	Song Purchasing	Android
Pandora	Interface	Draw
	Pause track	iOS
Geocaching	Interface	Android
	Selecting Cache	iOS

A host of application such as Twitter, Google translate, Sound hound, Pandora and Geocaching were taken up on both the platforms and both sets of tests were performed on them. The list of the results in each application is shown above in the table.

As we can see that out of 5 applications consisting of 9 functions tested, android takes the lead in 4 of them, iOS in 2 and 3 were a draw. So, the final result: Android the winner in usability category.

Table 2:Android vs iOS Security Results [13]

Category	Winner
Application Provenance	iOS
Application Permissions	iOS
Isolation	iOS
Encryption	Draw

Regardless, it is clearly depicted in these tests that with the correct combination of both software and hardware, both of these mobile operating systems can shine, and which of them the customer selects can come down to personal preference,

without worrying about a huge gap between the two platforms.

The Android security approach has two major weaknesses. First, attackers can use anonymous digital certificates to sign their compromised apps and post them on the Internet. Moreover, attackers can redistribute a legitimate app with a new certificate after injecting it with malicious code. Second, Android's permission system relies on users to make security decisions, which makes them open to social engineering attacks. The devices' users grant whether or not to give permissions to an app. Unfortunately, most users are not capable of making sound security decisions. On the other hand, iOS's security approach seems to be more resistant to attacks. First, the only place for iOS users to download apps is the App Store, where each app is tested for security violations. Second, Apple follows a strong signing model that prevents tampering with published apps. Also, the iOS permission model does not completely rely on the users' decisions. However, the Apple security approach with iOS with vetting is more restrictive and less conducive to developers.

In the security category, where trust is placed and user knowledge is required seems to be one of the primary differences between the Android and iOS approach. So, the winner in the security category: iOS

But the conclusion that can be drawn from this comparison is that usability and security are both are very important and possess their own traits of importance. Although android wins it in the usability category, it lags behind in the security department. So, there is always a tradeoff between both of them but there are certain design strategies that can be kept in mind to minimize this tradeoff.

VIII. CONCLUSIONS

This paper discusses the importance of both usability and security in the design of human computer interaction systems. We were first comparing them to determining if good HCI and HCISec systems could be generated without either of the two aspects. But as we studied the terminology we came to an understanding that both are significant. Then our focus shifted on which is more important. As we took a look at some scenarios and examples, we reached the conclusion that the importance of usability and security is purely situation based. There were some scenarios in which greater usability was required regardless of the security and in some cases security was the priority. There were even scenarios where both were critical to the success of the system. Also, as there does not exist any standard metric to measure security or usability, mathematical measurements are not possible. Also, the case study found out that in case of usability android takes the lead. But this usability makes the android platform compromise in

terms of security where iOS makes it big. Both of these platforms are extremely popular so there is no hands down definite winner. So, definite results are not present to prove the significance of one over the other. But considering the statistics and facts pertaining to various examples and scenarios that we discussed above, it would be safe to say that the best HCI system designs cater to both security as well as usability and that's why all the focus today is shifting to HCISec for Usable security.

REFERENCES

[1] Fakhreddine Karray, Milad Alemzadeh, Jamail Abou Saleh and Mo Nours Arab,"*Human Computer Interaction: Overview on the state of the art*", Vol. 1, Issue 1, March 2008 , Pattern Analysis and Machine Intelligence Lab., Department of Electrical and Computer Engineering University of Waterloo, Waterloo, Canada.

[2] B. Shneiderman and C. Plaisant, *Designing the User Interface: Strategies for Effective Human-Computer Interaction (4th edition)*, Pearson/Addison-Wesley, Boston (2004).

[3] Ronald Kainda, Ivan Flechais and A.W. Roscoe," *Security and Usability: Analysis and Evaluation*", 2010 International Conference on Availability, Reliability and Security, Oxford University Computing Laboratory

[4] N. Tractinsky*, A.S. Katz, D. Ikar —"*What is beautiful is usable*", Industrial Engineering and Management, Ben Gurion University of the Negev, Beer Sheva 84105, Israel, March 2000.

[5] ISO 9241-11. *Ergonomic requirements for office work with visual display terminals (VDTs) Part 11: Guidance on usability* (1998).

[6] Kirakowski, J. and Corbett, M. SUMI: "*The software usability measurement inventory*."-British Journal of Educational Technology 24, 3 (1993), 210-212.

[7] Erik Frekjmr, Morten Hertzum and Kasper Hornbmk: "*The software usability measurement inventory*." CHI 2000 • 1-6 APRIL 2000

[8] D. Balfanz, G. Durfee, D. Smetters, and R. Grinter, "*In search of usable security: five lessons from the field*," IEEE Security & Privacy, vol. 2, no. 5, pp. 19–24, 2004.

[9] A. Adams and M. A. Sasse, "*Users are not the enemy*," Commun. ACM, vol. 42, no. 12, pp. 40–46, 1999.

[10] K.-P. Yee, "*Aligning Security and Usability*," IEEE Security & Privacy, vol. 2, no. 5, pp. 48–55, 2004.

[11] M. A. Sasse, "*Computer Security: Anatomy of a Usability Disaster, and a Plan for Recovery*," in Proceedings of CHI2003 Workshop on Human-Computer Interaction and Security Systems, 2003.

[12] *Android vs iOS: A Usability battle* [HTML Document]. Retrieved (25.10.'16) from World Wide Web, http://spyrestudios.com/android-vs-ios-a-usability-battle/

[13] Ibtisam Mohamed, Dhiren Patel, "*Android vs. iOS Security: A Comparative Study*", 2015 12th International Conference on Information Technology - New Generations.