International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

An Extended Shackel's Acceptability Paradigm: a Balance of Security & Speed

Naveen Kumar, Arvind Kalia, Rakesh Kumar

Abstract: ***Today's world is full of technical equipments. Human lifestyle has been changed due to tremendous growth in Internet Users. There are different types of machines like mobile, tablet, laptop, desktop, etc. User Interface is an important concept in case of every machine. Prof. Brain Shackel proposed a paradigm for web-development in which, there is a number of parameters like Usability, Utility, Likability, and Speed. Utility, Usability, and Likability are important while designing a web portal yet without having a good speed, these factors are useless. Now, the effect of these parameters on user's lifestyles or lives is a big question need to be considered. In this paper, research is carried out to analyze the factors of Shackel's Acceptability paradigm. Some key factors have been identified for improving the speed of a website. In order to carry out this research a web-portal has also been analyzed using GTMetrix Tool. An Extended Paradigm has also been introduced in this direction with five parameters i.e. Usability, likability, Utility and in the core there is speed and security.***

Index Terms: ***Acceptability, An Extended Shackel's Acceptability Paradigm, Likability, Security, Shackel's Acceptability Paradigm, Speed, Usability, User Interface (UI), Utility.***

I. INTRODUCTION

In Today's world, there is a growing trend to migrate the information from traditional media to World Wide Web (WWW), which results in growth of Internet users. In order to design the User Interface (UI) of web-portals, a developer need to concentrate on many factors which affects UI. One factor of user interface is Usability. Usability is about creating effective user interfaces. But issue to be addressed is the need of usability, because it has been observed that human beings have extraordinary learning & adaptation. They can learn & adapt themselves even with the worst interface. But putting aside the inhumanity of this kind of situation, many specific key points are there, which a developer need to follow while developing the web-application's user interface. It has been observed that there is a strong effect of usability about how an application is perceived, because user interface of any application is means by which it is presented to the world. Additionally, it is observed from a magazine study that sometimes "Ease of User" may even put a direct effect on verbal recommendation & hence influence buying decisions of people. [2], [16]

More narrowly defined, usability measures how well users can use the system's functionality. Different dimensions of usability are subjective like satisfaction, error rate, learnability and efficiency. Usability should be defined in terms of "Ease of use". User must be able to use the website successfully. Usability is the extent to which a product can be used by specified users to achieve goals of effectiveness, efficiency and satisfaction in a certain context of use. Usability is attached with all tools used by humans and is extended to both digital and non-digital devices. Thus, it is a subset of user experience but not wholly contained. The section of usability that intersects with user experience design is related to humans' ability to use a system or application. Good usability is essential to a positive user experience but not entirely responsible. Website Usability is always more precise than how "good" the website is. If a website is not able to fulfill user's requirement, it indicates deficiency in functionality, not in usability. If the website is very expensive or crashes frequently, then it certainly detracts user's experience, but there is no need of user testing to narrate about that. [13]

This paper contains seven sections. First section introduces about the Usability. Section II contains the literature review of Usability and its effects. Shackel's Acceptability Paradigm is explained in section III. Then slow response time and key points of websites are described in section IV. Section V contains various caching methods. A proposed system is explained in section VI. Finally conclusions of the work are presented in section VII and in the last references for further reading are provided.

II. LITERATURE REVIEW

As per Moore's Law, processors speed increases to double in every two years. But users don't obey Moore's Law, as new generation's time is not that cheap. In point of fact, every year user's time is likely to become more expensive. User Interface that very often waste individuals time, impose a hidden cost which companies are never willing to pay. E.g. in case of customer support centers, saving of few seconds on every call may result into saving of millions of dollars for a company per year. For shrink-wrapped software, a poorly designed UI may have cost investment even after its sale. Some software companies may lose their complete profit of sale due to a customer support call. [10]

Manuscript published on November 30, 2019.
* Correspondence Author
Naveen Kumar*, Department of Computer Science, Himachal Pradesh University, Shimla, H.P., India
Arvind Kalia, Professor, Department of Computer Science, Himachal Pradesh University, Shimla, H.P., India
Rakesh Ku mar, Professor, Department of Computer Science & Applications, Kurukshetra University, Kurukshetra, Haryana, India

A study about many projects at University of Washington [21], several issues regarding user interface, found that developers don't have much experience about programming, have not so much appropriate opportunities to customize user interface to their task and work habits. In order to improve customization, it should be easier for users to direct these changes. While improving adaptation, better prediction can be made about user behavior and navigate the inherent tension between the dynamism of automatic adaptation and the stability required in order for the user to predict the computers behavior and maintain control. Usability and Acceptability are two main parameters, which are dictating the "ease of user" of web based applications.

A research study about the relationship between usability and acceptability of user interface has been done with the objectives: (i) effect of user with positive attitude about the usability, (ii) effect of acceptability on effectiveness, efficiency and satisfaction. The goal of this study was to improve the process and results about to improve the design of user interface. An experiment was done on 9 participants with different age groups. It has been found from the results that user acceptance for systematic Graphical User Interface has to be analyzed with more scrutiny. Ease of user, error forbearance and presentation are the main benchmarks in case of user performance and acceptance. [19]

A Framework has been proposed by Charles E. Downing and Chang Liu about the usability of website. Nine factors have been introduced i.e. Identity, Download Delay, Contents, Ease of Use, Trust Assurance, Made for the Medium, Responsiveness (It is different from website responsiveness, it is about to give the immediate response to the user or customer about the product), Promotion and Emotion. For evaluating Usability of 14 different company's websites a survey has been done. Number of survey respondents was 261. Each websites have been reviewed by at least 14 business students. Likert scale has been used in questionnaire and the range was from "Completely Disagree" to "Completely Agree". Questionnaire contains the questions about the above 9 factors and website usability. SPSS has been used to evaluate and Cronbach's Alpha to validate the responses. It has been concluded that web developers and business coordinators are advised to recognize that ease of use as well as the contents of the websites, are important features of web-portals. And the main observation about the usability is that these factors will not differentiate their websites from others. [20]

Poorly designed user interface may also cost lives of people. There was an incident of "The Therac-25 Accident" which took life of many people merely because of confusing User Interface. While designing user interface of the machine, safety measures were not been considered. [4], [11] In 1988 also, almost 290 people including 66 children were killed in a flight. Two main causes behind the scene were: (a) management error, (b) again User Interface which was poorly designed. [5] Later, a disaster occurred in 2003 and there was an oil spill from an oil tanker by a helm lever. Afterwards, in April 2006, a predator Unmanned Aerial Vehicle (UAV) crashed while patrolling the US border in Arizona. Cause behind the casualty was again UI, which was supposed to be designed with safety measures. [15]

So, it has been observed that usability is a key factor, which a developer should not refuse to notice when designing the user interface of any application. Poorly designed user interface of any application or device may result into a big accident. Usability is one key factor, but in case of website development there are some other factors also, which has been introduced by Prof. Shackel in an acceptability paradigm.

III. SHACKEL'S ACCEPTABILITY PARADIGM

Brain Shackel was a professor, who described that Utility, Likability, Usability and Speed are the main parameters, a developer need to follow while developing a website, which is shown in Fig. 1. All these parameters have been assigned weights and compared with cost of the system. Shackel characterized paradigm in different dimensions. [8]

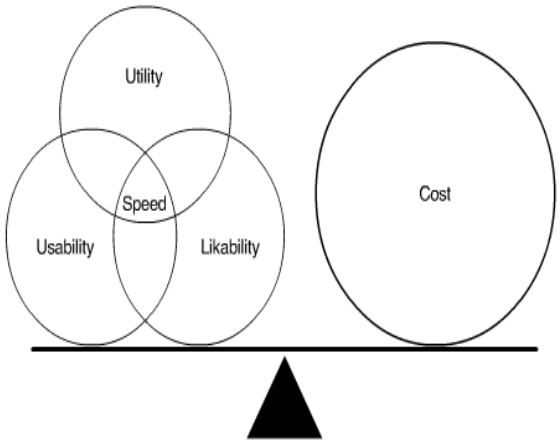

Fig. 1: Shackel's Acceptability Paradigm [8]

Although three factors viz., Utility, Usability, and Likability are important while designing a web portal yet without having a good speed, these factors are useless. User's satisfaction also depends on the response time of a website. Users will provide a negative feedback from website in which download time is more than eight seconds. Fast downloading of webpages leaves a positive impression on user whereas slow downloading works exact opposite of it. If the downloading of a page is slow, the user may get impatient & leave the page believing that there is an error. Further, Utility is functional efficiency of website. It ascertains the satisfaction rate about functionality of a web-portal. Other than this, Likability is subjective attitude of user about the system and the objective should be to maximizing the percentage of user response about the likability of the web-portal. Thereon, Shackel's Acceptability Paradigm also focuses on the usability in terms of speed. [17]

IV. SLOW RESPONSE TIME

People do not like to wait. Internet users have two complaints regarding websites: (i) difficult navigation, (ii) slow Page Load Time. There are some standard key points about web applications i.e.: (i) website should be loaded

within progressive demonstration of 8.6 seconds, (ii) load time should be decreased by 1.5 seconds for vigorous transactions, (iii) to escape frustration resulted from increasing budgets of user time, number of steps to fulfill tasks have to be minimized, (iv) useful contents should be loaded in 2 seconds whereas the one with less important can be loaded in 20 to 30 seconds, (v) linear feedback and performance information should be provided, (vi) download time of useful contents should be equalized so as to minimize the delay variation. [14]

So, speed is an important factor while designing a user interface of an application.

V. CACHING

Browser Caching and Domain Name System (DNS) Caching are two main methods, which can be used for improving the speed of a website. It has also been verified by analyzing a web-portal of Department of Computer Science & Applications, Kurukshetra University, Kurukshetra using GTMetrix & Pingdom Tools. These tools also suggested the same that speed of a website may be improved by using these two methods. [22][23]

A. Browser Caching

In Browser Caching, local machine will store webpage resource files, when user will visit a web-portal. At very first time, when a browser loads and displays the content of a webpage, it has to load several resource files i.e. logo, CSS file and other resources. These resource files are saved in local machine, and are got used when user visit other webpages of the same website. It results into faster loading of webpages for same users.[1]

B. DNS Caching

In case of Domain Name System (DNS) caching, when a user wants to visit a web-portal and types URL like *dcsakuk.co.in,* web browser asks router for the IP address. The router has a DNS server address stored, so it asks DNS server for IP address of that hostname. DNS server finds IP address that belongs to *dcsakuk.co.in* and then is able to understand which website has been asked for the content. This browser can then load appropriate page. It happens every time, a user visits new website. [3]

When any user wants to visit a website by its hostname, a request is initiated by web browser to the Internet. But the request will be completed only after "conversion" of the website's name into IP address. Till now, IP address and domain name of each website which has been recently visited are stored in the database of DNS. It is basically used to decrease the "Page Load Time" by using stored IP address in the system instead of sending the request every time to Internet. While improving the speed of a website, using these two methods, it may result into the problem of DNS Caching Poisoning. [24]

DNS Cache Poisoning:

Unauthorized domain name and their IP addresses may get inserted into the DNS database. Sometimes a DNS cache may be corrupted because of technical bugs or any other administrative mishap.[7] Whereas DNS cache poisoning may occur by different type of network attacks or some viruses. Network attacks may strive by entering invalid or unauthorized domain and IP address into the cache. Due to this, user may be redirected to: (i) a website full of advertisements or (ii) wrong website or (iii) generally a malicious webpage. E.g. suppose there is an "X" record in the cache of a bank website, its URL i.e. https://www.icicibank.com and IP address corresponding to the URL. Later on that record is changed by poisoning. Thereafter, when a user enters the same domain https://www.icicibank.com in web browser, he will be taken somewhere else. This creates a huge difficulty for popular websites. If DNS poisoning redirected user to a similar website which looks like the original. He might wind up suffering from a phishing attack like Whaling. [18]

Whaling:

It is an attempt to get someone's login information of a social media, banking website, email, etc. A similar website is provided to users to which they are already familiar. In most of the cases, user is asked for username and password. However, if users are not alert about this kind of situation, they will be in trouble. At the first attempt user will be on fake website. Then, after entering username & password, a message is shown to the user asking for valid username & password. Subsequently the original information is grasped by attacker and user is directed to original website. In the second attempt, the user will enter the username & password and will get logged in. In this situation, users will not get any idea about what happened behind the scene.

In 2008 FBI subpoena whaling scam, around 20,000 CEOs got affected and 2000 of them only hacked by clicking on a link in the email. The reason behind the clicking on that link was that they thought that a special kind of browser add-on will be downloaded to view the whole subpoena. But in reality, a hacker got the usernames and passwords of those CEOs by that link. As a result, companies were hacked and a hacker got all the information they needed. [9]

Conclusively, Usability is an important factor, which has been discussed in Section II. Now, graphics & images are used to improve the user interface as well as usability of any web-portal, whereas it will effect on speed of the web-portal. When a user tries to improve the speed using above methods that will affect security of the application. Prof. Shackel explained the parameters, Usability, likability, Utility and Speed. All these factors are important in case of website development, which has been discussed in Section III. But the Shackel's Acceptability Paradigm missed the important factor, as there is a tradeoff between speed and security of the website. In respect to this, An Extended Shackel's Acceptability Paradigm has been proposed in the following Section:

VI. AN EXTENDED SHACKEL'S ACCEPTABILITY PARADIGM

In Shackel's Acceptability Paradigm, Speed is only one factor which is in the core of other three factors (Usability, Likability, Utility). But as discussed in Section V, Shackel's Acceptability Paradigm missed the important factor i.e. Speed as there is a tradeoff between speed and security of website. So a new paradigm has been proposed.

In this proposed paradigm, speed is not only factor, which is in the core. New proposed paradigm contains Usability, likability, Utility and in the core there is speed and security. All these five factors are weighted against each other along with the cost of the application, shown in Fig. 2.

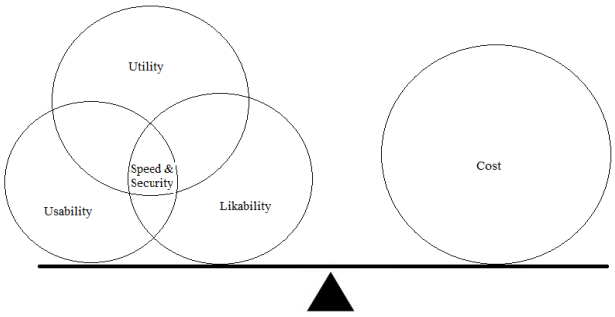

Fig. 2: An Extended Shackel's Acceptability Paradigm A

When speed gets increased up to a particular level, it starts affecting the security. So the developer has to decide that how much speed should be increased, without affecting the security of webpages. There is an inverse co-relation between speed and security. Speed is inversely propositional to security i.e. if speed improves to a particular level security decrease and vice versa.

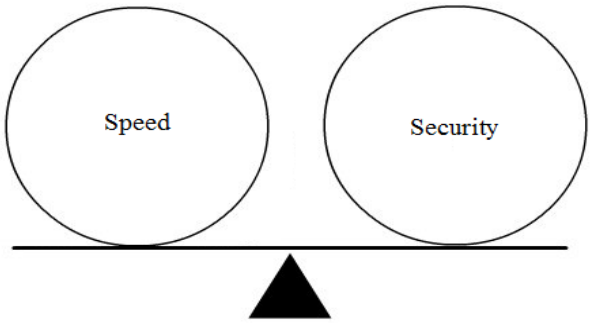

Fig. 3: An Extended Shackel's Acceptability Paradigm B

Both speed and security must be weighed against each other. There is a question that "How much speed should be increased so that security is not affected"? The solution for this problem is to keep both in a balanced way as shown in Fig. 3. So the balance of Speed and Security should be in the core of Usability, Likability, Utility and all these five factors should be weighted with cost of the application, which is shown in Fig. 4.

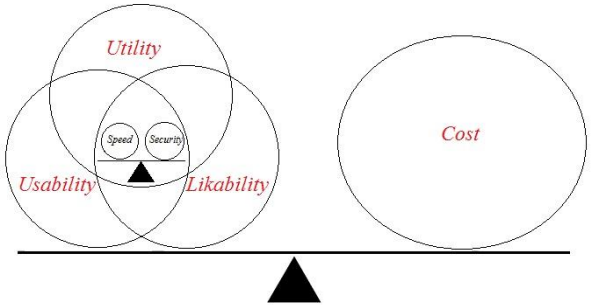

Fig. 4: An Extended Shackel's Acceptability Paradigm C

So, while designing a web-portal, a developer need to consider all the factors of Extended Shackel's Acceptability Paradigm. While a developer is improving an interface using the graphics, images and other contents, should keep in mind that all these contents should not affect on the speed of the website. And in case, if a developer tries to optimize the speed, security should not get affected. So there should be a balance of all the factors that is: (i) a website should have a user interface with effective usability, (ii) Speed of the website should be optimized, (iii) while decreasing the page load time, it should not affect on the security of the website, (iv) there should be a balance of speed and security, (v) cost of the web-application should be minimized. So it has been concluded that all these factors should be in a balanced way.

VII. CONCLUSION

In this paper, a lot of previous work has been reviewed and it is found that Usability is major task which affect on human lifestyle. Poorly designed or confusing User Interface may cost the lives of people. In order to improve the usability, there are some factors which affect the speed of the websites. Prof. Brain Shackel introduced a Paradigm, in which Utility, Likability, Usability and Speed are the main parameters, a developer need to followed while developing a website. Whereas Prof. Shackel's missed an important factor i.e. Security, as there is a tradeoff between Speed and Security of the websites. Speed and security are those two parameters, which are inversely propositional to each other. When a developer tries to improve usability of an application, speed is affected and when one tries to improve the speed, security is compromized. So, there should be an Extended Shackel's Acceptability Paradigm with five parameters: (i) Usability, (ii) Likability, (iii) Utility, (iv) Speed, and (v) Security and speed and security are in the core. A developer should maintain the balance between all these five factors, so that, there should not be a negative effect of one factor on another.

REFERENCES

1. Jackie Goldstein, "5 Fundamental ways to Improve the Speed of Your Website", [Online] Available: https://www.bluehost.com/blog/wordpress/improve-the-speed-of-your- wordpress-website-8357/?utm_source=google&utm_medium=genericsearch&kclickid=697c9788-5704-460b-a609-47f9da61505e&kenshoo_ida=Blue%20Host%20IDA&gclid=EAIaIQobChMI6fDn75y74wIVhIRwCh2tyQn6EAAYASAAEgKCqvD_BwE [Accessed: 08-Feb-2019]
2. "6.831 L1: Usability." [Online]. Available: https://courses.csail.mit.edu/6.831/archive /2008/lectures/L1-usability/. [Accessed: 11-Jul-2019].
3. B. M. A. M. graduate who brings years of technical experience to articles on SEO, computers, and W. Networking, "A Brief Overview of DNS Caching and How It Makes the Internet Better," Lifewire. [Online]. Available: https://www.lifewire.com/what-is-a-dns-cache817514. [Accessed: 08-Jul-2019].
4. N. G. Leveson and C. S. Turner, "An investigation of the Therac-25 accidents," Computer, vol. 26, no. 7, pp. 18–41, Jul. 1993.
5. C. W. Fisher and B. R. Kingma, "Criticality of data quality as exemplified in two disasters," Information & Management, vol. 39, no. 2, pp. 109–116, Dec. 2001.
6. "Dashboard | GTmetrix." [Online]. Available: https://gtmetrix.com/. [Accessed: 30-Jan- 2019].
7. "DNS Caching", PostCast Server, [Online] Available: http://www.postcastserver.com/help/DNS_Caching.aspx [Accessed: 09-Feb-2019]

8. "Figure 1.1-Shackel's Acceptability Paradigm." [Online]. Available: http://www.websiteoptimization.com/speed/1/1-1.html. [Accessed: 23-May-2018].
9. P. G. A. "How to Watch for 'Whaling' and Spear Phishing Internet Attacks," Lifewire. [Online]. Available: https://www.lifewire.com/what-is-whaling-2483605. [Accessed: 08-Jul-2019].
10. "Moore's law", Wikipedia. [Online]. Available: https://en.wikipedia.org/w/index.php?title=Moore%27s_law&oldid=896103909 [Accessed: 08-May-2019].
11. "OEC-An Investigation of the Therac-25 Accidents (Abstract)." [Online]. Available: https://www.onlineethics.org/Resources/therac25.aspx. [Accessed: 11-Jul-2019].
12. G. Tremlett, "Prestige oil tanker spill: three go on trial in Spain," The Guardian, 15-Oct-2012.
13. R. J. Jacob, "User interface," 2003.
14. "Response Time: Eight Seconds, Plus or Minus Two", Website Optimization, [Online] Available: http://www.websiteoptimization.com/speed/1/ [Accessed: 15-March-2019]
15. E. Bone and C. Bolkcom, "Unmanned Aerial Vehicles: Background and Issues for Congress," Report for Congress, through the CRS Web, p. 53, Apr. 2003.
16. M. Soegaard, "Usability: A part of the User Experience," The Interaction Design Foundation. [Online]. Available: https://www.interaction-design.org/literature/article /usability-a-part-of-the-user-experience. [Accessed: 12-Jul-2019].
17. "What is Usability?," The Interaction Design Foundation. [Online]. Available: https://www.interaction-design.org/literature/topics/usability. [Accessed: 12-Jul-2019].
18. "What Is DNS Cache and How to Flush It", [Online] Available: https://www.keycdn.com/support/dns-cache[04-October-2018] [Accessed: 09-Feb-2019]
19. 19. Vassileva S., "User Interfaces' Usability and Acceptability" [Online]. Available: http://mech-ing.com/journal/Archive/2011/9/89_Svetla %20Vasileva.pdf [Accessed: October, 2018]
20. Charles E. Downing and Liu C., "Assessing Web Site Usability in Retail Electronic Commerce", 35th IEEE Annual Computer Software and Applications Conference, 2011, pp 144-151
21. Weld, Daniel S., Corin A.,Domingos P.,Etzioni Oren and Wolfman S., "Automatically personalizing user interfaces", In Proceedings of the 18th international joint conference on Artificial intelligence (IJCAI'03), Key West, FL, January 3-6, 2003:1613-1619. and DASH, Digital Access to Scholarship at Hardward pp. 8.
22. GTMetrix, "https://gtmetrix.com" [Accessed: 10-Jun-2019].
23. Pingdom, "https://tools.pingdom.com/#59dd4582dd000000" [Accessed: 10-Jun-2019].
24. . Bradley Mitchell, "DNS Caching and How It Makes Your Internet Better [Online]. "https://www.lifewire.com/what-is-a-dns-cache-817514", [26 May, 2019] , [Accessed: 12-Jun-2019].

AUTHORS PROFILE

Naveen Kumar has published more than 10 research papers in National and International Journals. He has attended many workshops, seminars. His area of interest are HCI, HBC, UI/UX. He has delivered lectures in various colleges and universities on these topics.

Prof. Arvind Kalia has published more than 100 research papers in National and International Journals. He is expert member of AICTE, Member of Board of Studies in Computer Science and Engineering in different Universities. Expert member of Public Service Commission of different states. Remained Expert member of Promotion and Review Committee of NDRI, Karnal and Member for computerization of Indian Institute of Advance Studies, Shimla.

Prof. Rakesh Kumar has published more than 100 research papers in National and International Journals. He is member of Board of Studies in Computer Science in different Universities, Expert member of Public Service Commission of different states. His research specializations are HCI, HBC, Genetic Algorithm, Software Testing, Artificial Intelligence and Networking. He is a senior member of International Association of Computer Science and Information Technology (IACSIT)