Usable Computing Systems

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Abstract:

Awareness of the fundamentals when constructing usable computing systems is critical to accessing the full potential of user interactions. This report discusses solutions to be incorporated into the website of Rent-A-Scooter, whereby conventional standards may still need to be met as a result of reported user feedback. The purpose is to address the issues faced by the company regarding its website navigation through a criterion gathered from several fields of research. These examples include website usability, accessibility, and human-computer interaction to formulate a plan and improve their website moving forward. This report analyses which elements of conventional standards (such as WCAG 2.0) are missing and then tailors these recommendations towards their core user base and, more broadly, all website visitors. These suggestions are relevant in creating a pivotal opportunity to transform Rent-A-Scooter's website into a more effective sales tool, leading to more significant user traffic, sales conversions and, consequently, higher profit for the company.

Introduction:

Rent-A-Scooter's website has a core user base of 18–35-year-olds. Considering this, website navigation speed is the primary focus, from initially viewing the website to confirming a booking for an eScooter. Speed is the primary focus because attention has become the new currency of our economy. As internet usage between this age group of the core user base increases, there seems to exist a link between a short attention span and internet usage, according to Herr Andrew Fillmore [1]. Consequently, it is financially viable for the business to make booking an eScooter easy and fast to generate more significant profit. Improving navigation speed will ultimately increase ease of use. Since creating a booking becomes faster for the user, the more straightforward the booking process must be. However, this aspect can only be accomplished by first understanding human-computer interactions. Later in the report, this topic is discussed since it underlies how web designers and developers can use technology to help users better interact with their eScooter renting platform and reach a particular outcome, which in this case, is to rent an eScooter.

Ease of Use and Accessibility:

Requirements must be established to recognise where Rent-A-Scooter's website falls in the spectrum of ease of use and accessibility. The criterion by which the company is accessed is as follows: usability, the response time (the interval between the request of the data and the response sending that data), page load time (time taken for the web page to fully load onto the user's web browser), HTML/CSS errors, navigation structure, readability, and accessibility [2]. This criterion can then be used to improve on which standards and conventions are missing for the company's website.

This criterion has been inspired by a case study in India by Agrawal, G., Kumar, D. and Singh, M, who investigated the accessibility of e-government websites. Their results, shown in Table 1 [2], reveal how even government websites can meet below the expected standards required by the defined criteria. For instance, the most significant load time result is between 5.1 to 10 seconds, where most visitors would not wait this long, especially during our current attention span epidemic from recent generations. Another example is the broken links, where the most significant result is between 6-

25% broken links. Consequently, inaccessible web content scrutinises the opportunity for the user to revisit the website, diminishing the trust in the government service delivery mechanism [2].

Table 1 Usability parameters of Indian e-government Websites

Usability parameters	Website count	Min	Max	Mean	Standard deviation
HTML error	164	0.00	998.00	65.40	142.35
CSS error	164	0.00	1344.00	22.02	119.48
Broken links	164	0.00	973.00	72.48	143.62
Bounce rate	164	7.50	99.00	43.92	19.34
Alexa rank	164	444.00	6,625,034.00	599,025.77	1,170,723.44
Response Time(second)	164	0.43	38.78	2.93	3.92
Load time(second)	164	1.03	60.00	8.71	9.21
Total pageSize(KB)	164	23.61	43,333.87	3137.52	5279.18
Image size(KB)	164	0.42	29,911.04	2359.62	4380.43
Script size(KB)	164	0.00	16,322.56	409.13	1290.68
CSS size(KB)	164	0.00	1556.48	99.21	174.26
HTML size(KB)	164	2.08	2682.88	83.99	243.97
PlainText size(KB)	164	0.00	160.93	3.89	18.98

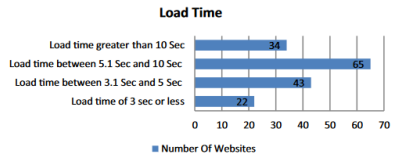

Fig. 1 Page load time of indian e-government websites

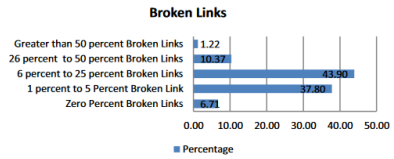

Fig. 2 Broken links in e-government websites

This paper emphasises how these factors are crucial in creating an effortless customer experience, as less duration on the website can result in fewer sales conversions for the company. The user must be able to rent eScooters easily, and this can be accomplished by reducing the response and page load time. 53% of users leave the site if the websites take longer to load than three seconds, according to Akamai [2]. In order to reduce the page load time, the web page size and image sizes must be minimised. The file sizes are typically composed of either HTML, CSS or JavaScript. These are languages designed to construct websites. Optimising any existing code by rewriting duplicates and removing redundant code that's not being used to reduce the file size is recommended. High-resolution images can be converted through lossy compression to reduce the image size. Lossy compression removes unseeable data from the human eye to reduce the image size whilst visibly looking similar to the original image. This change in reducing data without visible effect makes a significant impact; however, a potential drawback is the lower resolution of the compressed image. The company should strike a balance between their image quality and load time. Ideally, the resolution should be low enough for the page load time to be under three seconds, as this can persuade users to stay on the website for longer if we use Akamai's findings in practice.

It is equally important to note the navigation structure's contribution to ease of use when accessing websites. Broken links result in reduced internet traffic due to a lower website ranking. Lower ranking occurs because broken links can discourage users' attention and cause them to leave the website. Henceforth, the initial usage of Rent-A-Scooter's website could potentially be reduced. For this reason, reviewing all links for any potential redundant URLs is recommended.

Readability is defined as being easily understandable by all, irrespective of their educational and demographic background [2]. Mathematical models such as the Flesch–Kincaid readability tests can determine the difficulty level when reading a website. These models can be projected onto the company's website to see whether the website can be easily read. The literature suggests that using shorter sentences and words can be used to increase a higher score, where the acceptable range of scores is between 60 and 70.

Accessibility is addressed through WCAG standards, specifically 2.0, where it must meet AAA compliance. The compliance is hierarchical, whereby Level A is all accessible web documents. Level

AA is accessibility for disabled users, and Level AAA is full accessibility, composed of elements such as sign language interpretation or colour contrasts for the visually impaired.

An important consideration is an ongoing popularity of accessing webpages through alternative devices such as mobiles and tablets. According to the United States Census Bureau, more than two-thirds of the population access the internet on mobile devices [3]. As such, mobile readiness should be reviewed to ensure users can book eScooters through their mobile devices, as it is more likely to be used outside when an eScooter is needed to commute.

An argument lies where this study does not apply to Rent-A-Scooter due to India being less developed than the company's current location, alongside the location of its users who visit the site. A paper counterargues this notion from Kesswani, N. and Kumar, S. who did a cross-cultural analysis of G7 and BRICS countries investigating website accessibility. It depicts how BRICS countries (such as India) are still within WCAG standards but have a different mobile readiness than G7 counties.

Table 4 Percentage of problems and warnings in G7 and BRICS government website accessibility

Group/Ministry	Home	Defense	Education	Finance	Health	Foreign affairs	Average
G7	12.4	9.7	17.6	14.6	10.5	35.3	100.0
BRICS	13.1	15.9	10.9	12.2	23.2	24.7	100.0

Table 4 [4] reveals how the percentages between the accessibility of different government departments are similar in both groups, especially in categories such as Home and Finance having a lower margin than others. However, Table 6 [4] (from the same study as Table 4) separates these figures per the WCAG principles and shows a substantial difference in the robustness between G7 and BRICS countries. These findings suggest that although mobile readiness is less developed, the argument needs sufficient evidence to make such a claim. Hence, the study by Agrawal, G., Kumar, D. and Singh, M. is relevant to this report. A similar argument can be imposed on how India does not withhold the same cultures as Western civilisation, so the behaviours of web user engagement must differ. Despite this, it does not weaken the evidence of the cross-cultural analysis portrayed, so it cannot be taken into consideration any differently than the previous point.

Table 6 Total number of Problems WCAG principle-wise in G7 and BRICS government websites

Group	WCAG Principle	Ministry						Total
		Home	Defense	Education	Finance	Health	Foreign affairs	
G7	Perceivable	43	70	27	66	10	43	259
	Operable	29	47	47	17	11	155	306
	Understandable	8	12	15	9	6	16	66
	Robust	341	123	889	241	214	282	2090
	Total	421	252	978	333	241	496	2721
BRICS	Perceivable	44	127	87	70	35	109	472
	Operable	35	56	38	31	28	60	248
	Understandable	2	4	5	9	9	14	43
	Robust	31	40	237	250	43	226	827
	Total	112	227	367	360	115	409	1590

Even historically, issues with usable websites remain relevant to this day. A paper by Dave Gehrke and Efraim Turban reviewed 47 papers and over 40 websites to discover the determinants of a successful website design back in 1999 when e-commerce websites were only beginning to rise. Regarding ease of use, page load time and navigation efficiency have been consistent with the defined criteria for the company’s improvements. According to a survey conducted by Hamilton (1997), speed (i.e., slow speed) was the number one complaint of Web users (77%) [5]. To improve page load time, it was suggested to reduce the number of graphics used, the number of animation/multimedia used, and progressive rendering (this refers to prioritising text over graphics to load first), all contributing to slower speeds. To improve navigation efficiency, to use well-labelled and working links ensures users can have a seamless experience when traversing through the

website. Keeping navigation consistent can make new and returning users familiar with the website, leading to more profitable sales as users are comfortable progressing towards the checkout section. An effective search engine can create greater customer satisfaction as it can return results that the user is looking for, rather than being disappointed and leaving the site. Lastly, avoiding links that open up to new browsers or pop-up ads is crucial to withholding attention as these can be an invasive user experience, which can annoy the user to the point of leaving the site.

HCI (Human-Computer Interaction):

In order to fully understand the usability of websites, it is vital to look at human-computer interaction (HCI). HCI is how humans interact with computers, using interfaces to enable engagement. Understanding the principles of HCI can lead to better usable computing systems.

One approach is to look at the general scope of HCI and how it relates to design. According to the United States Naval Academy, this refers to context, the user's cognitive abilities, and memory [6]. Context can be met by displaying what users expect to see. For instance, Rent-A-Scooter's website should be perceived as an eScooter company using graphics and text related to its theme. The user cognitive abilities refer to how users do not remember website shortcuts, so users should not be expected to remember them. This is because humans have limited memory. As Miller concluded, humans can only remember 7 ± 2 items [6]. Any revisiting users are less likely to remember the content if it exceeds this number. This rule can be used in grouping objects such as bullet points or menu items that are similar semantically to make pages easy to navigate.

Consequently, this also uses all the available space on the website. The users' cognitive abilities refer to the ability to understand the website. However, how the web developer may think how users will visit the website may deviate from how users navigate the website in the real world. This is why all website functions, such as buttons or hyperlinks, must be visible to the user. Another factor to be considered is immediate feedback for every action performed. For example, if a user clicks a function on a web page with no apparent response, then confusion will arise. This can be implemented by changing the properties of an object, dialogue boxes or adding sound. However, as users can be unpredictable, they must plan for user interactions and potential mistakes they may make. As such, it is suggested that the company host a focus group to identify common navigational routes with an understanding of how users interact with the website. Overall, introducing intuitive feedback loops to actions consistently throughout the site can improve the ease of use by understanding the design elements with HCI.

Conversely, a more recent paper on HCI by Ren, X., Silpasuwanchai, C. and Cahill, J. suggests that a more evolved framework must exist that has been developed from HCI, known as Human-Engaged Computing (HEC). This model focuses on how the interaction between humans and computers can maximise human potential and survival through Eastern perspectives such as mindfulness. HEC is composed of four values, according to the paper: (1) synergy, (2) balance, (3) wholeness, and (4) improvement of improvement [7].

Synergy is the holistic interaction between computers and humans, complementing each other's weaknesses in social problems since computers lack human factors and humans lack scalability. Balance refers to the full development of both parties, as in the current situation, technological development is perpetuated when human development is neglected. This restoration reveals a greater capacity for both sides to reach their full capabilities. Wholeness is the understanding of the human individual, acknowledging organic attributes such as empathy within the technological progression. Lastly, improvement of improvement is meta improvement - how we can improve

improvement. Establishing the correct beliefs can lead to better people creating better interactions with technology.

These critical values in this approach can be used to reflect the current website of Rent-A-Scooter. By reviewing whether these values are met with how users access their website, the company can better understand how to facilitate more meaningful interactions when booking an eScooter. These interactions can lead to happier customers due to the usability and convert more sales because more people are inclined to use the website rather than the company's competitors.

Conclusion:

Small businesses such as Rent-A-Scooter can seamlessly fall behind the conventions of website development without realising it. Henceforth, it is adamant about understanding the limitations which hold them from reaching higher sales. By analysing the existing literature mentioned thus far, the evidence gathered strongly suggests focusing on increasing speed, decreasing abstraction, and guiding the user on a journey without requiring more cognitive effort than required to achieve the outcome. An argument can be made that perhaps simplicity can play a vital role in the reconstruction of this website, in making every object (buttons, images, text) on the front end (the part of the website that the user visibly sees and can interact with) to be transparent and functional. This simplicity can be implemented by starting with a blank space and only adding what is required to make a booking (the navigation journey from the homepage to checkout). Afterwards, those objects will be designed and constructed in a way that's intuitive to being seen as an eScooter company, either by adding multimedia surrounding the business theme or by making the website content specific to renting eScooters for short periods.

Concurrently, HCI must be considered a principal in designing and building the website. Without this, the meaning of constructing something "usable" would simply fall apart. Computers are becoming more integrated with humans over time, so the intermediatory interconnection between the two is as important as ever in this current climate of technological development. Therefore, the interaction framework between humans and computers must also adapt to ever-changing situations in an effort for each side to synergise interchangeably and push the advancements of humans and computers. Without this component, the evolution and survival of humans and technology would slow down or potentially collapse. It is crucial to place this engagement at the forefront of development to create maximum usability and accessibility. If this component is followed correctly throughout, humanity can collaborate with technology and have the potential to produce new efforts to continue both our and technology's survival towards the unpredictable future.

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