Analyzing Accessibility of Components of a Website to Increase the Usability.

Sai Vikram Alladi
Department of Computer Science
Central Michigan University, USA
Email: allad1s@cmich.edu

***Abstract*—Websites are being used in any business, organization, educational institute, social networking, E-Commerce, or revenue-creating stream. Websites are accelerating the interaction of services for people, so it is important to analyze the components of websites to accelerate usage and accessibility. The uses of navigation bars against shortcut navigation bars and the use of navigation bars versus search boxes are analyzed in this article. This paper also looks into methods for improving the effectiveness of a website's video section as well as the significance of tooltip elements that appear when a user hovers over photos or navigation bar items. The study attempts to shed light on how these elements affect website performance and user experience. The results of this study can be used to improve user experiences and boost website performance by informing website design and development methods.**

I. Introduction

Human-computer interaction (HCI) is the study of the design, evaluation, and implementation of interactive computing systems for human use. Websites are one of the most common types of interactive computing systems, and thus HCI is directly related to the design and usability of websites.HCI principles and techniques are applied to the design of websites to ensure that they are accessible, usable, and effective for users. For example, usability testing is a common HCI method used to evaluate the usability of websites. In this process, users are observed as they interact with a website, and their actions and feedback are used to identify areas of the site that are confusing or difficult to use. Based on the results of the usability testing, website designers can make changes to improve the user experience and make the website more effective. The connection between HCI and websites is crucial because it ensures that websites are created in a way that is user-friendly, effective, and efficient. Website designers can build websites that are accessible to a variety of users and that suit their requirements and preferences by incorporating HCI principles and techniques into the design process.

Websites have grown in importance as a result of the internet's huge growth. We depend on the internet to do our work and keep ourselves entertained, from online buying to entertainment. Have you ever considered the numerous parts that make up a website, though? Many different parts of a website come together to form a user-friendly interface. In this research paper, we will analyze the various components of a web page, including the average steps to access a component, search boxes, navigation bars, and video components.

A crucial component of web design is the flow to access a component. The user experience can be dramatically impacted by the component's flow. A poorly laid out web page can lead to confusion, dissatisfaction, and even website closure. We can determine the best component arrangement for a better user experience by examining the component flow on a web page. A web page's navigation bars are yet another crucial element. Users can easily reach various website areas due to navigation bars. The user experience can be improved by a well-designed navigation bar that offers users a simple and intuitive menu. A shortcut navigation bar is a sort of navigation bar that enables users to quickly access frequently visited or significant online pages. It usually has links to sites like the homepage, contact page, about page, or commonly frequented areas of the website and is placed prominently, either at the top of the page or in the sidebar.

On websites, video elements have grown in popularity. Videos may effectively and visually communicate information. Yet, badly made video elements might provide a bad user experience. We will compare how keyboard buttons and the video bar are used as we examine how video components are used and also suggest if anything is needed to increase the usability of video components.

A tooltip is a graphical user interface element that appears when a cursor is hovered over an item, providing additional information about that item. Tooltips can be used to clarify the purpose of a button or link, provide a description of an image, or display metadata about a data point on a chart, among other use cases. They typically contain a short amount of text, but can also include images or interactive elements. Tooltips are commonly used in web design, as well as in desktop and mobile applications. The proposed work section of the paper discusses the definition and layout of the tasks, dataset information discusses the data set information that was produced to analyze the components, and evaluations discuss the findings and suggestions related to each task. The website I built in order to illustrate the findings and suggestions made in the evaluations section is described in Section 7.

In my research, I have analyzed the usability of the navigation bar versus short cut navigation bar, the usability of the navigation bar versus the usability of the search box, understood the usage of the tooltip component when used with a navigation bar and a combination of anchor and image component of a website and we also tried to improve the

usability of video components by the analyzing and suggesting some suggestions.

To analyze the above-mentioned things, I have performed 4 tasks and created new datasets manually by making people perform the tasks. Task 1,2,3 were done in a combination of in-person and virtual, but task 4 was done totally in person. I have created a data set of 30 people for task 1,2,3 and for task 4, I have created a data set of 10 people.

The whole analysis of components is done on my university website, that is Central Michigan University and the URL of the website is cmich.edu , the Home Page is shown in Figure 1.In the end, based on the finding of tasks done, I have created a website to depict the findings, I want to show the findings and suggestions given by analyzing the website by the newly created website. Search Box was most utilized among the search box and navigation bar, shortcut navigation among the navigation, and shortcut navigation bar. A questionnaire was conducted to understand the tooltip component over a picture and a navigation bar component, and some suggestions were given to enhance the usability and efficiency of video components in a website.

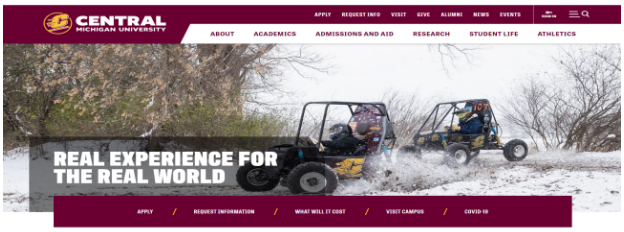

Fig. 1. HomePage Of Cmich.edu

II. Related Work

Saha and Sangita have done an analysis of 10 different websites that are being used in everyday life. They have mentioned a specific task for each website and calculated the time taken for each person to do the task and declared which website is most usable and accessible on basis of that [1]. Adepoju evaluated 4 different network provider websites in Nigeria by using automated tools Achecker, Mobile SEO, WAVE, and TAW, and they also tested the usability by performing 5 manual tasks on all the websites and checking the completion rate of the tasks [2]. Valerian has evaluated a staff portal of an Indonesian university website, they have used the sus method and questionnaire-based approach, their goal was to evaluate the working of the staff portal in terms of accessibility and usability as a whole and they have also suggested a new design to accelerate the usability and efficiency [3], In this paper they have used two methods for evaluating, that are System Usability Scale (SUS) [4] and User Experience Questionnaire (UEQ) [5]. Geetanjali has created a questionnaire survey that is used to collect data from select respondents (N=415) regarding B2C E-commerce websites and analysis is performed using structural equation modeling [6]. Li and Li reported that many e-commerce applications often failed to meet customers' requirements. They evaluated the usability criterion for business-to-customer (B2C) websites by considering two questionnaires: Q1: Choose the appropriate factors in the questionnaire scale, and Q2: Evaluated the importance of the chosen factors [7]. L.Hasan assessed the usability of nine websites from Jordanian universities using various evaluation criteria. These criteria, which fell into five groups, included navigation, architecture, usability and communication, design, and content [8]. Nouman suggests that websites should be tested regularly to identify and address usability and navigation issues and user feedback should be incorporated into website design and development. I completely agree with this suggestion and in my paper, I have tested the usability of the navigation bar and some more components [9]. Qasrawi discusses the technical aspects of four websites from a Palestine institution, including response time, information-passing protocols, and webpage traffic. Here, automated techniques like Jmeter and Immuni Web were also applied [10]. Huang talks about the various types of HTML elements, JDBC features, and video components that can be used today to increase the website's interactivity are discussed in this paper. This paper is useful, but my paper focuses on how components are used and how easily they can be accessed in relation to one another [11].G.Khade has developed a machine learning model to determine whether a webpage is attractive or not in order to draw the attention of a random internet surfer. However, I don't think this solution is particularly creative because different intentions may be behind each random internet surfer [12]. Vlasenko suggests analytical and heuristic evaluation techniques to comprehend the frequently used elements of an online learning environment and some recommendations to enhance those elements [13]. Aripiyanto used a similar approach was used for the analysis of the junior school website [14].Wang discusses the relationship between computer multimedia and its applications in the real world and how to make those apps more usable by utilizing the upcoming technologies [15].Ziyao talks about developing a novel user interface to improve the usability of making kites with augmented reality technology [16]. Jiao proposes a design study that investigates Norman's three-level theory, combines the Desmet product emotional response model, and suggests a way to create an interface [17]. All these papers have new interfaces created using the web browser extension technique to accelerate the usability in its specific requirements [18] [19] [20] [21] [22] [23] [24]. For example, [18] Wikxibit solves the issue of being able to fetch and show any Wikidata or its cross-referenced web APIs and [20]ROPE is an interface that helps content providers to edit its content as per requirement. By taking usability considerations into account, in and Hsieh studied the website design criteria with various gender-specific preferences. Taiwanese undergraduate and graduate students made up the participants. There were 123 women and 113 men present. 236 questionnaires were used in total. The relevance of website interface design was scaled differently for each gender, with many discrepancies. For the male participants, compatibility, minimal action, and adaptability of websites

were crucial elements. However, compatibility, learnability, and user advice were chosen by the female participants [25]. There have been previous studies conducted in evaluating the usability as well as the accessibility of different genres of websites like educational websites [26], e-government websites [27], [28], airline websites [29], hotel websites [30], [31] and so on to mention a few.

III. Proposed Work

Here in this paper, I propose 4 tasks to understand and analyze the usability of the web components mentioned. Below I am going to explain the tasks that were performed.

A. Task I

Understanding how users access the component can help improve the user experience of the website. If users are struggling to find the component through the navigation bar, we can optimize the navigation bar to make it more intuitive and user-friendly. On the other hand, if users are easily finding the component through a shortcut navigation bar, we can make that shortcut more prominent or provide additional shortcuts to other frequently accessed components. Analyzing how users access the component can also help improve efficiency. If users are able to quickly access the component through a shortcut navigation bar, it can save them time and effort. This can be especially important for users who need to access the component frequently, such as employees of a company who need to access a particular tool or resource on a daily basis, students who want to access their portal frequently, in case of delivery website this can be useful for tracking the order and many more like that.

We can gather data on how many users are accessing the component through the navigation bar versus the shortcut navigation bar, and use that data to make informed decisions on how to optimize the website.

I made 30 people perform this task and the primary goals were to see the average number of steps taken to access a component in a particular website by navigation bar and also compare the usage of the main navigation bar and shortcut navigation bar. The task was to find a table component on the website which has a header as ”Main Campus Graduate Tuition” as shown in Figure 2.

Fig. 2. Main Campus Graduate Tuition Component

I specified the component in the task and the question was ”What is the cost per credit hour for doing a master’s in CMU irrespective of the stream for international tuition (tuition fee for international students)”. I highlighted the cost and international tuition in the task question and made it a hint because I wanted to make the question clearly so that the participants can go in the right direction as it was a very complex website. There were many table components and some were of tuition for graduates too, So I wanted to make the question clearly so that they do not end up clicking on the wrong components. After reading the task, I told the participants to view the whole page as it was lengthy and there were different ways to approach the component. The main navigation bar and shortcut navigation bars are displayed in Figures 3 and 4.

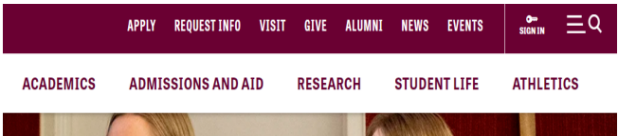

Fig. 3. Main Navigation Bar of Cmich.edu

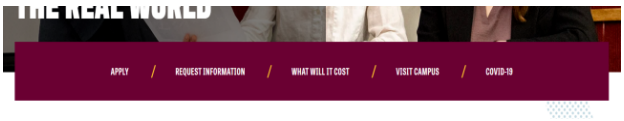

Fig. 4. ShortCut Navigation Bar of Cmich.edu

I also told the participants and also wrote in the task document that, the participants are not allowed to use the search box for this task, as I wanted to understand and analyze the approach of the navigation bar versus the shortcut navigation bar in this task. In Figure 5, the task sheet provided to the participants is shown.

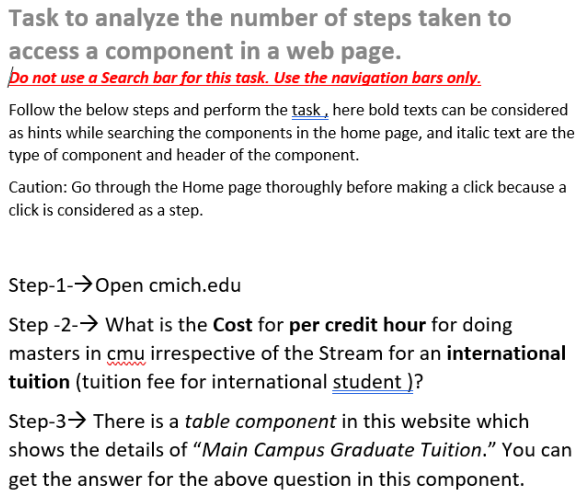

Fig. 5. Task 1

B. Task II

By this task we can understand if people are more aligned to the usage of a navigation bar or a search bar, we can

understand which approach is more comfortable for the users and what can be the steps taken if we want to accelerate the usage of that component. Through this task, we can understand the pro and cons of the component in the design aspect, which affects the usability aspect. If we assume there is a shopping website like Amazon, which has got tons of traffic on its website and website is not in a good design, it results in a situation where users can't find a search box or a specific item they want to, amazon will surely lose its customers. If we can check how many people use which approach, we can make the required changes as required and modify the design which can make people find their needs in a minute, they will be obviously shopping more on the website and visiting the website and shopping more often. By tracking the usage of the search bar and the navigation bar, you can gather data that can help you understand user behavior and preferences. This data can be used to inform decisions about website design, content strategy, and user experience to increase usability. Utilizing the navigation bar could be more challenging than using the search bar for people with disabilities, such as visual impairments. You can make sure that your website is accessible to all users, regardless of their ability, by analyzing how visitors interact with it. If the usability is more through the Search Box, people with disabilities can use it in a more efficient way. Here in task 2, I have collected a dataset of 28 people. The main purpose of this task is to find out which approach is mostly used by the people on a website, whether is it a navigation bar or a search box. Here every participant was given a Word document that contained the task, which states," Find any three student organizations in CMU". There is a page named "STUDENT ORGANIZATION AT CMU" on the cmich.edu website, so I wanted to check what approach people use to find this page, is it a search box or navigation bar, or a combination of both?

In Figure 6, the task sheet provided to the participants is shown.

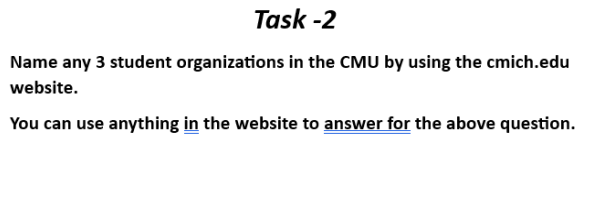

Fig. 6. Task 2

C. Task III

Analyzing the tooltip component is important because it can provide insights into the effectiveness of various ways of presenting information to users through websites. A tooltip component provides information to users in a clear and concise manner, which can create a positive user experience. Through this analysis, we can understand how a tooltip component can be used by analyzing how the people are wanting it to be. If we use a tooltip aspect in a nav bar, it can provide additional information about that specific component in the nav bar, which can help people avoid clicking on multiple tabs or save them time in exploring the website. Providing the information in a way that is accessible to the viewer of the website can increase user satisfaction.

This helps the people take the decisions about choosing the component as per their requirement or need. Navigation bars often have limited space in a website, so this additional information using the tooltip component will be an add-on to make the accessible for people more easily. It can avoid including more unnecessary text in the nav bar, which can help to build a good and neat design. So using a tooltip component can make an advantage in space of the website, providing clarity about the component, making the usage easy, and will accelerate the usage.

Basically, a tooltip component is nothing but, when a user focuses on that particular component by making a mouse over or by any action, it should provide some information or some action at that component. So here the hover that I am talking about is a mouse over hover, which means when a user places a mouse pointer on a component, we can notice some additional information popping up, to make the user understand more about that component. Adepoju and Valerian have used the questionnaire-based approach in their papers and also have included how effective a questionnaire-based approach can result in [2] [3]. In this task, participants were given a questionnaire to fill out in order to learn whether they would like a short overview of the navigation bar's components when hovered, a change in text color when hovered, a link to a description of an image that is next to the image, or text about the image that would be displayed on the image when hovered, and whether they would like a highlighted animation when hovered.

In Figure 7, the task sheet provided to the participants is shown.

As you can see in the task paper, in the second question I talked about a picture that might be a link with text about it when the user hovers over it before clicking. I have shown the component in Figure 8 for a better understanding.

D. Task IV

Video is a highly engaging means of content that can catch the attention of website visitors and convey information in an entertaining way. A paragraph that is 1000 lines can be neglected, but a video that has the same matter can be more efficient than the paragraph in conveying the information. Videos can be the crucial aspect for telling stories on kids' websites and they can break the complexity of understanding big text content. That can be the reason why many people are now learning things from YouTube rather than reading books. Videos can create a good interaction with people who are using the website. Video components in a sales website can increase the sales of products if we consider Amazon, there are n number of products, and before purchasing many people would watch the videos of that product, in this case, they can make the decision-making very easy. Video Components in a website can be used for advertising products, services

Name: **Age:**

Tech/Non-Tech: **Cmu/NonCmu:**

Task-3

Q1) Do you like if there is a short description when you hover on a component of nav bar which describes about component?

Yes **No**

Q2) Would you like information to be shown on the picture that might be a link when you hover on it?

Yes **No**

Q3) When you hover over a component in nav bar do you prefer a color change of text of the component, or do you want a short description or both?

Color **Desc** **Both**

Q4) Will you like a highlight of the nav bar component or not?

Yes **No**

Fig. 7. Task 3

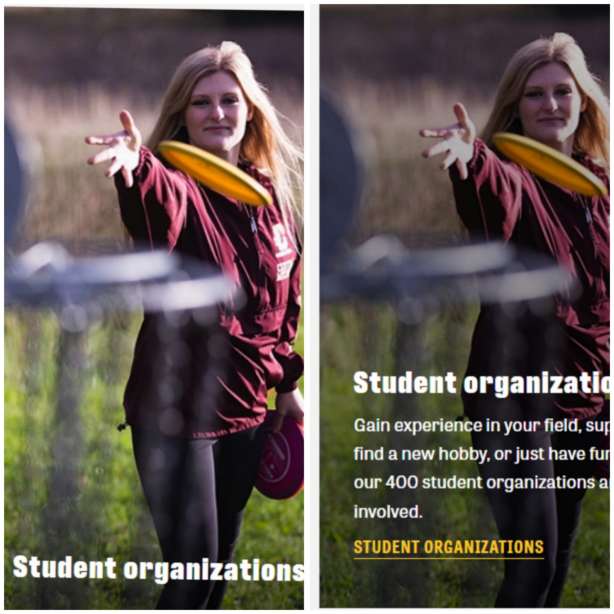

Fig. 8. Picture Component Before and After Hovering Without making a click

or promotion of brands, organizations, etc. Nowadays video advertising is a popular way to reach the target audience.

In this task, I have observed that there are many video components that are trying to let people know more about CMU.I wanted people to use the autoplay feature of the video component the increasing usability. I wanted to understand which approach is more utilized by the people when they are

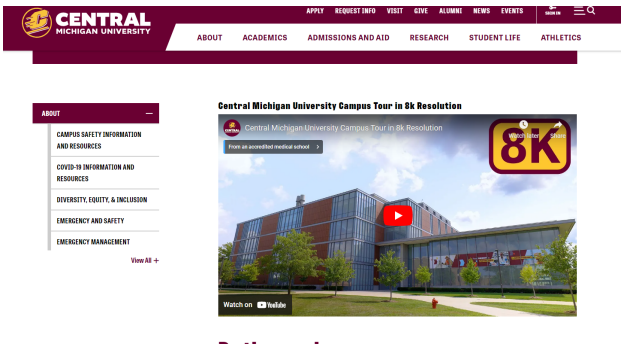

Fig. 9. Task 4 Youtube Component

using the video component and which is more efficient among the two approaches.

The Component that I have analyzed on the cmich.edu website is displayed in Figure 9.

In this task, I checked if the persons would operate a YouTube video by keyboard keys or a video progress bar, and secondly, I wanted to check which approach would give the information to the user more efficiently. To understand these two points from the users I have created a task, in which I picked a video from cmich.edu which is streamed from YouTube. The video which I have chosen is of duration 1 minute 27 seconds, so I told each participant that he/she will be given 25 seconds and a set of 3 questions to answer from that video. Even though the video is 1 minute and 27 seconds long, the main reason for providing each participant with only 25 seconds is that if they are given less time, they may decide to fast-forward the video. I then gave the participant the option

to select between the keyboard keys or the video progress bar. The three questions asked in the task to measure the efficiency of usage of the video progress bar versus keyboard keys are displayed in Figure 21, which is the image of the word document shown to explain the task to the participant.

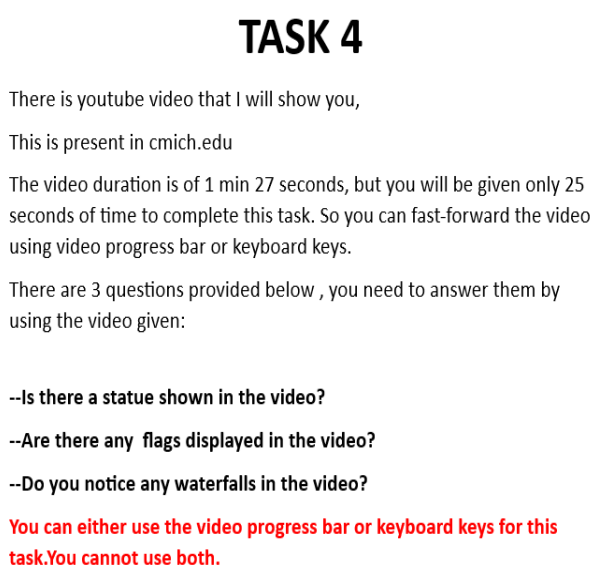

Fig. 10. Task 4

IV. DataSet Info

Here in the section, I am providing Information about the datasets to get a more clear picture. For the first 3 tasks as the number of people are more, I am illustrating the pictures of 5 records of the data set, while for task 4, as the data set is of 10 members, I am displaying the total data set.

A. Task I

In Figure 11, we can see the features to be as Approach, Time Taken(Sec), Number of Steps, Cmu/NonCmu, and Time Taken before making the First move(Sec). The Approach column specifies the approach that people have chosen, that is MN means the Main Navigation Bar and SN means the Short Cut Navigation Bar. Time Taken(Sec) specifies the time taken for the person to find the component from his/her first click made. The number of Steps is nothing but the number of clicks made to reach the component.Cmu/Non-Cmu speaks about if the person belongs to Central Michigan University or not, the reason to create this column is to check if there is any difference in the approach as the website that is being analyzed is of Central Michigan University.

B. Task II

The data set here contains the following features Person Count, Approach, Time-Taken, Number of Steps, CMU/NON-CMU, Age, Tech/Non-Tech, Time Before making the first Click, and Male/Female. The approach feature in the data sets talks about if the approach is by Navigation Bar, Search Box, or a combination of both. A combination of both can be understood as, if the user first uses the nav bar and doesn't find the required thing he/she then chooses the search box or vice versa. Time taken is the time window between the first click on the website to the second they find the page on the website that contains the student organizations list at CMU.CMU/NON-CMU feature speaks about if the user is part of the CMU organization or not.Tech/ Non-Tech speaks if the user is into some technical stuff or not. The time before making the first move depicts the time window which a user takes to explore the website to get what they want, in this time the user may explore the components or the user may search for the search box and maybe try to find some keys words in the navigation bars or the website, and the last column speaks lets us know if the user is a male or female. In the Approach column, the data set contains the values S, N, and C which mean search approach, Navigation bar approach, and combined approach. The columns M/F, CMU/NON-CMU contains values 1 and 0 respectively.

C. Task III

Here in Figure 13, we can see the dataset that I created for task 3, which was to understand the usage and analyze the tooltip component. As mentioned above, in this task people were given a questionnaire of 4 questions. In the dataset, Cmu/NonCmu column contains if the person is from Central Michigan University or not, the Age of the person, Tech/Non-Tech speaks if the person is a technical person or not. This was determined by asking the person and by cross-checking their present education or qualification.M/F specifies the gender of the person, either male or female. The male is represented as 1, and the female as 0. Column Q1 speaks about the answer to question 1, Y means Yes, and N turns out to be No. This follows as same for the Q2 and Q4, which are questions 2 and question 4. While in Q3, that is question 3, there were 3 options provided which are Color, Desc, and Both. The option Color is represented to be as C in the data set and D for the option Desc and B for the option Both.

D. Task IV

Here in Figure 14, this dataset speaks about the task that was performed to understand and analyze the usage of the video component of a webpage.here in this task, all the participants are from the CMU and as mentioned this task for performed in person. I also checked that all the people had a good bandwidth that is above 200mbps while performing the task to avoid the issues of video reloading speed while people trying to fast forward the video. The approach column of this dataset speaks if the person has chosen the keyboard keys approach or the video progress bar approach to fast forward the video. Progress represents the video progress bar and the keys represent the Keyboard keys. While everyone had 25 seconds to finish the job, I was curious to see if the average approach time would be shorter. So I have created a column to check the time. To check the accuracy of the approach, I have created the No. of

	S No	Name	Approach	Time taken(sec)	Number of steps	Cmu/Non Cmu	Time taken before making the first move(sec)
0	1	Kiran	MN	70	7	CMU	6
1	2	Fazal	SN	12	1	CMU	30
2	3	Pavan	MN	28	3	NON CMU	23
3	4	Lasya	MN	61	5	NON CMU	15
4	5	Datta	SN	16	2	NON CMU	25

Fig. 11. Dataset 1

	Person Count	Approach	Time Taken	Number of Steps	Cmu/NonCmu	Age	TECH/NON TECH	Time taken before making the first move(sec)	M/F
0	P1	S	49	4	1	23	T	3	1
1	P2	N	40	5	1	22	T	43	1
2	P3	S	36	4	1	25	T	12	1
3	P4	C	23	5	1	25	T	53	1
4	P5	N	55	5	1	21	T	10	1

Fig. 12. Dataset 2

	S.No	Cmu/NonCmu	Age	Tech/Non Tech	M/F	Q1	Q2	Q3	Q4
0	1	1	23	Tech	1	Y	Y	B	N
1	2	1	22	Tech	1	Y	Y	B	N
2	3	1	25	Tech	1	Y	Y	D	Y
3	4	1	25	Tech	1	Y	Y	B	N

Fig. 13. Dataset 3

Sno	Name	Approach	Time	No of Correct
1	Fazal	Progress	24	3
2	Kiran	Progress	19	3
3	Pavan	Keys	25	2
4	Abhi	Progress	15	3
5	Professor	Progress	25	2
6	Karthik	Progress	22	2
7	Duyen	Keys	25	1
8	Vamsi	Progress	20	3
9	Sumanth	Progress	22	3
10	Bhaskar	Progress	16	3

Fig. 14. Dataset 4

Correct column to check how many of the answers given by the person where correct.

V. Implementations

For illustrating the findings of the task, I created a website using HTML, CSS, and javascript. I have used the iframe component to stream a youtube video and used the autoplay feature to increase the usability as per my suggestion in task 4. I used Python language to do the analysis and used Panda's library to be more precise. The main functions that were used while the analysis when count values (), and groupby() aggregations. I have used the websites of my professors and syllabi pdf's in the website that I created to depict the findings. The syllabus copies were downloaded from my college blackboard portal.I have also used the images of professors to create image anchor/link components in my webpage from their websites. [32] [33] [34]

VI. Evaluations

A. Task I

Many users investigated the main navigation bars by clicking on the components like Academics and Request info, the maximum number of steps observed in the data set was 7. Three steps have been determined to be the average number of steps to access this specific component. The shortcut navigation bar's main purpose in any website is to make the

accessibility of components easy, which are hard to access in the normal procedure or using the normal main navigation bars. Thirty people were present, of which seventeen used the main navigation bars and thirteen used the shortcut navigation bar as shown in Figure 15.

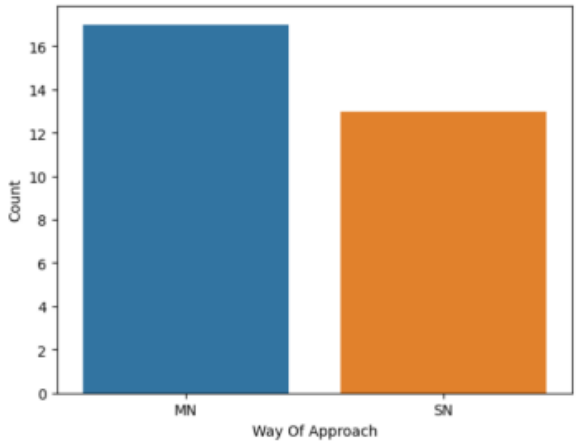

Fig. 15. Approach Versus the Count Of Persons

I admire how the CMU website makes accessibility easier by using a quick navigation bar. However, I can see that the shortcut navigation bar is not being used to its full potential. Out of 10 Cmu members, 5 used the main navigation bar, and the other 5 used short cut navigation bar. Out of 20 Non-CMU members 12 have used the main navigation bar and 8 have used the shortcut navigation bar. In order to increase the use of shortcut navigation bars, I advise that each one be unique on the website. So that the shortcut navigation bar would hit the user at his/her first glance. The majority of people who chose the shortcut navigation bar took more time to make their first click, according to my analysis of how long people took to see the whole home page before they click. The majority of those who selected the Main navigation bar did not take much time to explore the whole home page before the first click, as shown in Figure 16. The MN means the main navigation bar and the SN means the Shortcut navigation bar.

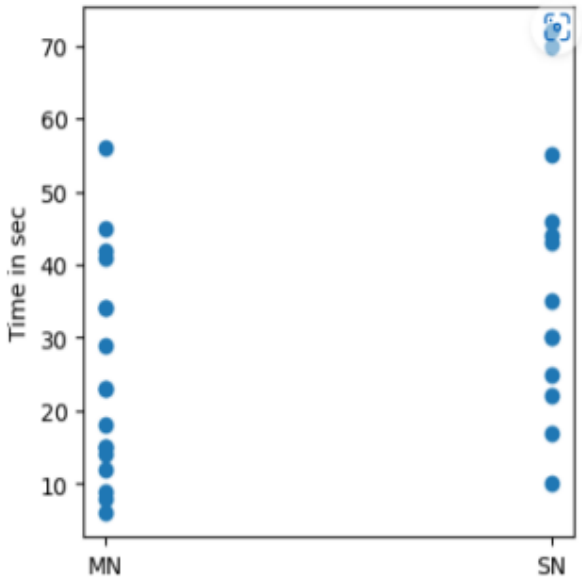

Fig. 16. Time Taken Before the First Click Versus The Appraoch

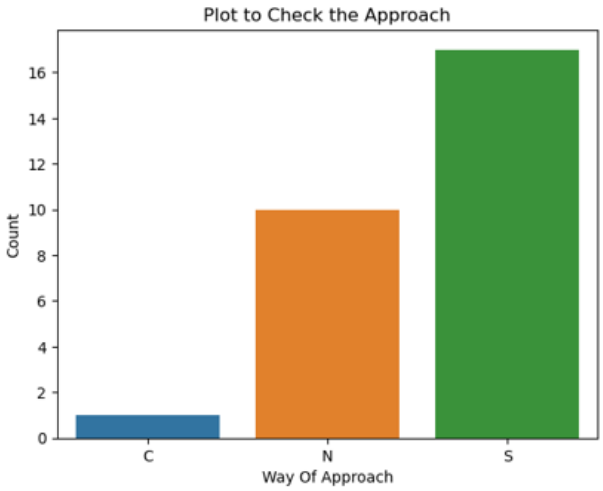

Fig. 17. Approach versus Count

B. Task II

The values S, N, and C mean the Search box, Navigation bar, and Combination of both respectively. By seeing Figure 17, we can understand that the maximum number of people have used the Search bar approach to access the component.17 users used the search box, 10 used the navigation bar and 1 person used a combination of both. Here among 28 people, one person used a combination of the navigation bar and search box. This person has used the navigation bar first and hasn't got the answer to the task and then the person has moved to the search box. There was a search box specialized for the Searching programs at CMU on the webpage, There was also small writing above that search box that says's "Search Our Programs ", even though this was used by a person when this search box utilized the person did not get the result, then he just checked the other search box and then has clicked on the search box which was meant for the normal search of the website. In this task, I have also tried to analyze the approach of the participants by seeing if they are Cmu/Non-CMU and if they are technical or Non-Technical. 5 participants used the Search Box,3 used the Navigation and 1 person used a combination of both among 9 Cmu Participants.12 used the Search Box, and 7 used in Navigation Bar among the 19 Non-Cmu participants.

8 people used the navigation bar and 14 people used the Search box among the 22 Technical People.3 people used the search box and 2 have used the navigation bar, among 5 Nontechnical People. In both aspects, we can see either Cmu/non-Cmu, Technical or Non-Technical, people tend to

use the Search Box the Most. The average number of steps via the search box approach was 4 and the average number of steps via the navigation bar was 3, but however, people had no chaos to try different options to find what they want while using the search box. The average time taken before making a first click for the navigation bar was 17.5 seconds, while the average time for making a first click via the search box was 8 seconds. The average time to find the component using the search box was greater than the navigation bar, but it was only a second more than that of the navigation bar, But while people performing the tasks, I could notice that the search box was very easy and comfortable to most of the participants. The search box which is standard for all searches has got an icon depiction on the home page, once you click on this a dialog box opens to search the component, whereas the specialized search box for searching a program had the general approach of the search bar like a blank open bar to type. I suggest that the standard search box should be rather a normal search box than an icon so that it can be more accessible than the icon approach.

C. Task III

In this task, 28 members answered Yes to Q1 and 2 members answered no to Q1. So as the majority speaks, people want a description for the nav bar component when asked if they want a description or color change. 29 members have answered yes to Q2 and 1 members have answered no to Q2. So we can conclude that almost the maximum number of people wanted to see a text when they hovered over an image which is a hyperlink before clicking it. 24 members have chosen the option “Both” for Q3, which states that people liked a color change of the nab bar heading text with a short description.4 members have chosen the option”Desc” which means they only need the description, they don’t need both or only the color change. While only 1 has opted for the only color change, eliminating the other two approaches. I can here conclude that more number of participant wanted both a short description and color change of text when hovered. For Q4 maximum number has chosen option “No”, that is 23, so people have chosen a nav bar with a color change of its text over the highlighted approach when hovered and they also wanted a short description of that component in the nav bar which can make it a lot easy to choose.

I have also tried to analyze the answers from the perspective of Cmu/NonCmu, Tech/NonTech, and Male/Female. For question 3, Out of 25 technical people 21 have chosen option ”Both” that is they wanted both the color change and the description when hovered, while 4 out of 5 nontechnical people have chosen ”Both”.If we check question 3 with Cmu/Non-Cmu perspective,16 out of 19 Non-Cmu, and 9 out of 11 Cmu people have chosen the option ”Both”.22 out of 25 males have chosen the option both, and 3 out of 5 females have chosen option both. So here I can conclude that either male or female, technical or Non-Technical Person, Cmu or NonCmu member, most of the people are wanted both description and the color change of the text when hovered.

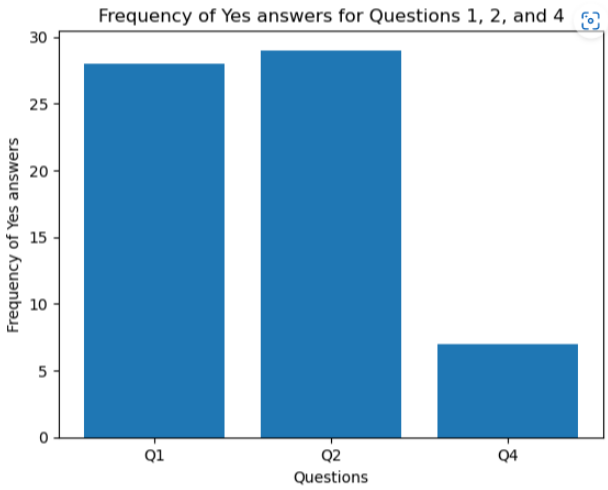

Fig. 18. Questions 1,2 and 4 Versus Number of ”Yes” Answers

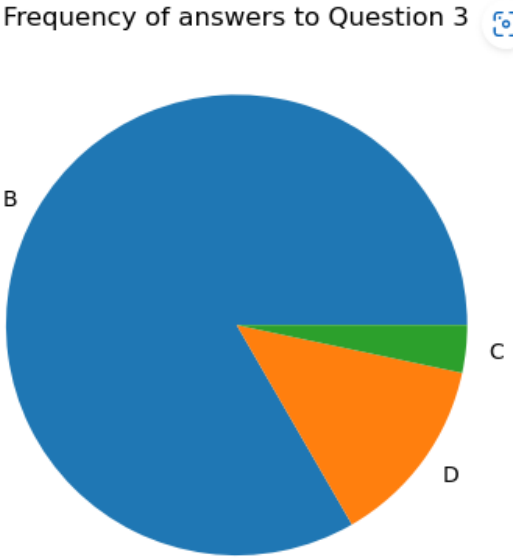

Fig. 19. Options chosen For Q3

If we see at question 2, 5 out of 5 nontechnical persons,24 out of 25 technical persons,10 out of 11 CMU members,19 out of 19 NonCmu members,24 out of 25 males, and 5 out of 5 females have chosen option ”Yes” that is they wanted a description when hovered on an image that is a link.

If we see at question 4, 0 out of 5 nontechnical persons,7 out of 25 technical persons,4 out of 11 CMU members,3 out of 19 NonCmu members,5 out of 25 males, and 2 out of 5 females have chosen option ”Yes” that is they wanted a highlighted animation when hovered. So we can see many of them did not want the highlighting to happen when hovered on a navigation bar component, which was in the cmich website, you can see this in Figure 20.

Fig. 20. Highlighting of a Component when Hovered

D. Task IV

After suggesting to use of the autoplay feature for the video components in a website, then I wanted to check which approach most people use to access the video component in the website, whether is it the video progress bar or the keyboard keys. I also wanted to check which approach would be more efficient and which approach would deliver more information to the people on their first visit to the video component. So as discussed above I have performed the task and created a dataset. I would that out of 10, 8 people were comfortable using the video progress bar over the keyboard keys. So the video progress bar was more chosen than the keyboard keys by the users.

I made sure that all the participants had internet speed above 200mbps to make sure that wouldn't affect the efficiency of the video fast forward time, so out of 10 people 8 people were comfortable with the video progress approach, and if we see the efficiency part 8 people 6 people have given 3 correct answers for the 3 questions and 2 of them gave 2 right answers out of 3. Two people have chosen the keyboard keys and among the 2 people, one has given 1 correct answer out of 3 and the other one has given 2 correctly. If we look at the time aspect, I have calculated the average time of the video progress bar approach and the keyboard keys approach. The average time taken to complete the task by video progress bar approach was 20.3 seconds while the average time taken to complete the task by the keyboard keys approach was 25 seconds. By this we can understand some people who used the video progress bar, have answered the questions correctly in below 25 seconds while all the people who used the keyboard keys utilized the full time, that is 25 seconds, and were not totally correct with the answers. I observed that the people who used the video progress bar were quite comfortable finding the answers. I observed that some of the people who used the video progress bar started the video and just hovered on the progress bar without actually making a mouse click, they moved the cursor without making a click on the bar, and they see a small window that pops out and shows the preview of the video at that specific time point, so they did not have a need to watch the whole video to answer the questions or understand the content. I have even noticed that the people who made a click on the progress bar and dragged the cursor of the video progress bar actually had buffer pictures on the video screen, there was also a small preview popping up. In Figure 21, the first image only shows hovering over the progress bar and dragging the mouse, which shows a small preview window with the image of that specific point and the original

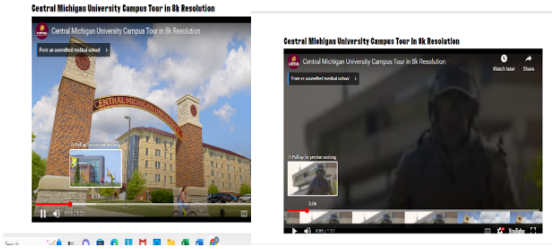

Fig. 21. Hovering/Dragging on the video progress bar with and without clicking

video playing at that point regardless of where the mouse pointer is, while the second image only shows clicking and dragging, which produces the same effect on the video screen and small pop-up window. So by this task, I conclude that using the combination of autoplay and the video-progress bar and disabling the keyboard keys can give better efficiency to the users who are accessing the video component of a website.

VII. Website Created to Depict the Findings

I have created a website using HTML, CSS, and Javascript to exhibit the task findings. The home page of the website that I have created is shown in Figure 27. I have created a Navigation bar, a video component, and a shortcut navigation bar on the homepage of the website.

For the navigation bar, I have created a short description of the navigation bar component when hovered over it, to make people understand what is present or what information they are gonna get when they click over that specific component of the navigation bar. You can see this in Figure 22

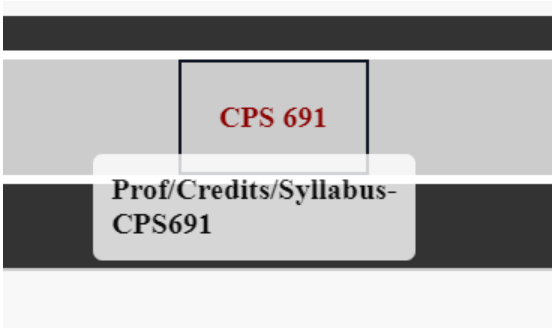

Fig. 22. Hovering over the navigation bar component

I have created a shortcut navigation bar in such a way that is totally different from the main navigation bar in terms of color and layout and shape, so that it gets the first glance of the visitor, so as to make accessibility easy to that particular component. The website I have created is a course catalog, so I guess the most frequently used component in this can be a syllabus of the course, so I made it to be the shortcut navigation bar.It is displayed in the Figure 23 Rather than using a search box icon on a website, I have suggested using a standard approach as exhibited in the website that I have created.It is displayed in Figure 24.

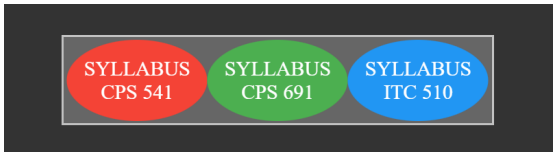

Fig. 23. Shortcut Navigation Bar

Fig. 24. Search Bar

I have also implemented a video component on the Homepage of the component, using the autoplay and disabled the keyboard keys control to keep it more efficient. I am displaying the code snippet that I have used in the website. I have implemented the autoplay feature and also muted the video by default so that the autoplay would not disturb the users on opening the webpage and disabled the keyboard controls. Figure 25 shows the code snippet. The ”controls=1” in the

```
</marquee>

  <iframe width="720" height="390"
  id="youtube-video"
      width="560"
      height="315"
      src="https://www.youtube.com/embed/wmFMCAzNE70?controls=1&disablekb=1&autoplay=1&mute=1&"
      frameborder="0"
      allow="autoplay; encrypted-media"
      allowfullscreen
  ></iframe>
</div>
```

Fig. 25. Code Snippet For Youtube

YouTube embed URL means that the video player controls will be shown, such as play/pause, volume, full-screen toggle, etc, ”disablekb=1” means that the keyboard controls will be disabled, so users can’t use the keyboard to control the video, ”autoplay=1” means that the video will automatically start playing as soon as the player loads, ”mute=1” means the video will be muted initially. Lhasan in his paper has clearly mentioned the options that are different from the old-time flash component of HTML vs the new HTML5 options, those are autoplay, controls, height, muted, poster, preload, etc [11]. For the components in the main navigation bar, I have created three web pages that represent three courses, and on each page, there is a component that describes the Professor’s information, which was an image with a link component, which is the respective professor’s image. When hovered over it, it displayed a short note of the name of the Professor, email id, and phone number of the Professor. When clicked on this image it redirected to the webpage of the respective professor. The component’s image is displayed in Figure 26

VIII. Conclusions

Short Cut Navigation Bar to be its maximum potential, need to be differentiated from the normal navigation bar. The Search Box is the most used among the navigation bar and search box. So every website must have a search box and rather than being an icon it needs to be a big search box that is visible on the home page. Picture component that is an anchor, should have a description of it when hovered. when you hover over

Fig. 26. Image/Link component that displays short info about it when hovered

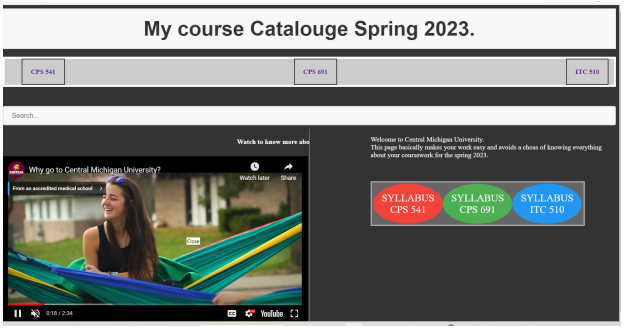

Fig. 27. HomePage Of the Website

a navigation bar, you need to give a short description of it to increase the usability and accessibility of the component. It is better to use the autoplay feature and mute the video by disabling the keyboard keys to make it more efficient and make it comfortably accessible for the users.

REFERENCES

[1] S. Saha, D. Basumatary, A. Senapati, and R. Maity, "Is there any further scope for improving the efficiency of modern websites?" pp. 1–7, 2021 6th International Conference for Convergence in Technology (I2CT) April 2021 Maharashtra, India.

[2] S. A. Adepoju, A. Ekundayo, A. O. Ojerinde, and R. Ahmed, "Usability and accessibility evaluation of nigerian mobile network operators' websites," pp. 1–7, 2019 2nd International Conference of the IEEE Nigeria Computer Chapter (NigeriaComputConf) October 2019,Zaria, Nigeria.

[3] A. Valerian, H. B. Santoso, M. Schrepp, and G. Guarddin, "Usability evaluation and development of a university staff website," pp. 1–6, 2018 Third International Conference on Informatics and Computing (ICIC) October 2018, Palembang, Indonesia.

[4] Z. Sharfina and H. B. Santoso, "An indonesian adaptation of the system usability scale (sus)," pp. 145–148, 2016 International Conference on Advanced Computer Science and Information Systems (ICACSIS) October 2016, Malang, Indonesia.

[5] H. B. Santoso, R. Y. K. Isal, T. Basaruddin, L. Sadita, and M. Schrepp, "Research-in-progress: User experience evaluation of student centered e-learning environment for computer science program," pp. 52–55, 2014 3rd International Conference on User Science and Engineering (i-USEr) September 2014 Shah Alam, Malaysia.

[6] G. Sahi, "User satisfaction and website usability: Exploring the linkages in b2c e-commerce context," pp. 1–4, 2015 5th International Conference on IT Convergence and Security (ICITCS) August 2015, Kuala Lumpur, Malaysia.

[7] F. Li and Y. Li, "Usability evaluation of e-commerce on b2c websites in china," *Procedia Engineering*, vol. 15, pp. 5299–5304, 2011, cEIS 2011. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1877705811024830

[8] L. Hasan, "Evaluating the usability of nine jordanian university websites," pp. 91–96, 2012 International Conference on Communications and Information Technology (ICCIT) Hammamet, Tunisia August 2012.

[9] N. Nouman and A. Umer, "Web navigation and usability analysis of educational websites in pakistan," pp. 57–62, 2019 Seventh International Conference on Digital Information Processing and Communications (ICDIPC) Trabzon, Turkey ,May 2019.

[10] A. Qasrawi, S. VicunaPolo, and R. Qasrawi, "User experience and performance evaluation of palestinian universities websites," 2021 International Conference on Promising Electronic Technologies (ICPET) pp 73-77 November 2021 Deir El-Balah, Palestine.

[11] M. Liu and X. Huang, "Analysis of multimedia application and research based on web pages," pp. 109–112, 2020 International Conference on Intelligent Computing and Human-Computer Interaction (ICHCI) Sanya, China May 2020.

[12] "Classification of web pages on attractiveness: A supervised learning approach," pp. 1–5, Khade, Ganesh and Kumar, Sudhakar and Bhattacharya, Samit.

[13] K. Vlasenko, I. Lovianova, S. Volkov, I. Sitak, O. Chumak, A. Krasnoshchok, N. Bohdanova, and S. Semerikov, "Ui/ux design of educational on-line courses," *CEUR*, vol. 3085, 2021.

[14] S. Aripiyanto, M. Azhari, R. Munawarohman, S. U. Masruroh, D. Khairani, and H. T. Sukmana, "Usability improvement through user interface design with human centered design (hcd) method on junior high school websites," *2022 Seventh International Conference on Informatics and Computing (ICIC)*, pp. 1–7, 2022 Seventh International Conference on Informatics and Computing (ICIC) pp 1-7 December 2022 Denpasar, Bali, Indonesia.

[15] Y. F. Lanchuan Wang, "Research on application of perceptive human-computer interaction based on computer multimedia," 3rd International Conference on Intelligent Design (ICID) 2022.

[16] L. Y. H. S. X. L. S. Z. Ziyao Li, Wei Song, "Design and implementation of traditional kite art platform based on human computer interaction and webar technology," 2nd International Conference of Intilligent Computing and Human Computer Interface(ICHCI) November 2021 Shenyang, China.

[17] Z. Jiao, "Research and application of human-computer interaction based on user experience," 7th International Conference of Intelligent Computing and Signal Processing (ICSP) 2022.

[18] D. R. K. Tarfah Alrashed, Lea Verou, "Wikxhibit: Using html and wikidata to author applications that link data across the web," UIST '22 2022.

[19] S. B. G. K. M. G. Abdelkareem Bedri, Yuchen Liang, "Fitnibble: A field study to evaluate the utility and usability of automatic diet monitoring in food journaling using an eyeglasses-based wearable," IUI '22 2022.

[20] B. Wang, Z. Jin, and G. Mysore, "Record once, post everywhere: Automatic shortening of audio stories for social media," User Interface Software and Technology 2022.

[21] M. X. Liu, A. Kuznetsov, Y. Kim, J. C. Chang, A. Kittur, and B. A. Myers, "Wigglite: Low-cost information collection and triage," User Interface Software and Technology 2022.

[22] J. Li, Z. Yan, E. Jarjue, A. Shetty, and H. Peng, "Tangiblegrid: Tangible web layout design for blind users," User Interface Software and Technology 2022.

[23] D. Hu and S. W. Lee, "Scrapbook: Screenshot-based bookmarks for efective digital resource curation across applications," User Interface Software and Technology 2022.

[24] M. Ehtesham-Ul-Haque, S. M. Monsur, and S. M. Billah, "Grid-coding: An accessible, eficient, and structured coding paradigm for blind and low-vision programmers," User Interface Software and Technology 2022.

[25] C. J. Lin and T.-L. Hsieh, "Exploring the design criteria of website interfaces for gender," vol. 53, pp. 306–311, International Journal of Industrial Ergonomics 2016. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0169814116300063

[26] S. A. Adepoju and I. S. Shehu, "Usability evaluation of academic websites using automated tools," pp. 186–191, 2014 3rd International Conference on User Science and Engineering (i-USEr) September,2014 Shah Alam, Malaysia.

[27] S. A. Adepoju, I. S. Shehu, and P. Bake, "Accessibility evaluation and performance analysis of e-government websites in nigeria," vol. 7, pp. 49–53, Journal of Advances in Information Technology 2016.

[28] N. E. Youngblood and J. Mackiewicz, "A usability analysis of municipal government website home pages in alabama," *Government Information Quarterly*, vol. 29, no. 4, pp. 582–588, Social Media in Government - Selections from the 12th Annual International Conference on Digital Government Research (dg.o2011) 2012. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0740624X12000706

[29] S. Alwahaishi, V. Snasel, and A. Nehari-Talet, "Web site assessment in the airline industry: An empirical study of gcc airline companies," pp. 193–198, 2009 Second International Conference on the Applications of Digital Information and Web Technologies 2009.

[30] C. Ip, S. Qi, R. Leung, and R. Law, "Hotel website performance evaluation: A fuzzy analytic hierarchy process approach," pp. 2443–2446, International Conference on E-Business and E-Government 2010.

[31] F. Maryto, P. W. Handayani, A. A. Pinem, and F. Azzahro, "5-star hotel website quality criteria analysis," pp. 1–6, 2018 Third International Conference on Informatics and Computing (ICIC).

[32] [Online]. Available: http://people.se.cmich.edu/liao1q/

[33] [Online]. Available: https://www.cmich.edu/people/AHMET-UGUR

[34] [Online]. Available: https://www.cmich.edu/people/MICHAEL-LEE-JOHNSON