# Adaptable Web Search User Interface Model for the Elderly

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## *Abstract*

The elderly population is rapidly increasing worldwide, but many face challenges in using digital tools like the Internet due to health and incapacity issues. Existing online search user interfaces (UIs) often overlook the specific usability needs of the elderly. This study proposes an adaptable web search UI model for the elderly, based on their perspectives, to enhance search performance and usability. The proposed UI model is evaluated through comparative usability testing with 20 participants, comparing it to the Google search UI. Effectiveness, efficiency, and satisfaction are measured using task completion time, error rate, and subjective preferences. The results show significant differences ($p > 0.05$) between the proposed web search UI model and the Google search UI. The proposed UI model achieves higher subjective satisfaction levels, indicating better alignment with the needs and preferences of elderly users. It also reduces task completion time, indicating improved efficiency, and decreases the error rate, suggesting enhanced effectiveness. These findings emphasize the importance of considering the unique usability needs of the elderly when designing search UIs. The proposed adaptable web search UI model offers a promising approach to enhance the digital experiences of elderly users. This study lays the groundwork for further development and refinement of adaptable web search UI models that cater to the specific needs of elderly users, enabling

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designers to create more inclusive and user-friendly search interfaces for the growing elderly population.

***Keywords:*** web search user interface, elderly, user center design, web search model, online prototyping, comparative usability evaluation.

## 1. Introduction

All countries must deal with a large population of aging people while Internet searching simultaneously becomes a common daily activity for everyone. Based on survey findings, two out of three elderly people use the Internet for a variety of things, including activities such as reading news, listening to music, and searching for online services [1, 2]. These tally with the findings of commonly used search engines such as Google, Bing, and Yahoo [2]. The first step of searching for information always begins with the search query [2-4]. Then, the users will be got by a list of relevant websites based on the search query that will eventually be viewed by them [2, 5]. Next, the user will scrutinize the website's contents. Provided that the website contents are interesting to them, they will stay on the website, and if it is not as relevant as they thought, the user will rephrase the query and recheck the results [6]. This process is expected to be iterative, until the user satisfied with their query results. However, this procedure could take a while and use up a lot of cognitive resources especially for elderly users [5]. One of the factors influencing cognitive flexibility, processing speed, and environmental adaptability is age. As a result, older users may have trouble reformulating their queries [1]. As revealed from the analysis, older users may use fewer keywords and queries, but the complexity of their selections and the timing of searches will increase [1, 7]. The elderly can find it challenging to carry out routine everyday tasks as their cognitive and physical capacities deteriorate with age. Their social life may also be impacted by the ageing process, which restricts their social interactions and activities [8, 9]; this makes safety and security more important [10]. Several complex health conditions are also characteristics of the elderly. The usage of the Internet can be hampered by some physical and functional health issues [11, 12]. It is more challenging for the elderly to access the Internet since they frequently have physical limitations and impaired vision [12, 13]. Additionally, they frequently have poor memories, which makes it harder for them to learn new Internet procedures quickly [12, 14]. Sarah et al. [15] discovered that those with diabetes, independent of the state of their diabetes, had slower cognitive speed and executive function. In order to design strategies to halt or slow cognitive decline, further study is required to understand the mechanisms causing de-creased cognition in diabetic individuals. Additionally, people with documented diabetes appear to have less muscle strength [16].

The amount of time that elderly users spend on the Internet decreases as they age [1, 17] due to a decline in cognitive abilities. Both older and younger people use search strategies to make the most of their knowledge and abilities [17, 18] but the elderly person tends to search less yet gets better information and more accurate results. However, older users were unable to change their search habits or styles in order to adapt to a newer search strategy [19, 20], especially for extremely difficult search tasks. In addition, elderly users experience physical issues like cognitive impairment, visual impairment, poorer color recognition, and a lack of familiarity with technology and computers [19].

The physical difficulties are the most apparent ones that must be considered when searching through web pages. This may impact text reading, audio listening, etc. [21]. One of the most significant physical issues while performing a search task is eyesight. Since aging often affects eyesight, most elderly people suffer from it. Users interact with computers through graphical UIs. If a person has a visual impairment, it is harder to read small texts and the images available on the interfaces, which also would affect the perceived meaning and grammar of the contents presented. Thus, comprehension is much affected. Despite this, visually impaired people may experience misunderstandings of search queries. They may not get the expected search results [22], and the time consumed to attain the result would be higher. As a person ages, motor skills will also deteriorate, resulting in less effective hand movements in pointing the mouse precisely and actions related to the use of the keyboard and other input devices. Due to locomotor difficulties, tasks such as clicking, dragging, double-clicking, pointing with a mouse, and typing with a keyboard require more time for searching tasks and make them feel more difficult to use [23].

Existing online search models and applications were designed based on the general user or developer. There is no perfect design and not one which specifically meets the needs of the elderly. Besides, existing online search UIs are well-developed, but the elderly still face usability issues. In addition, there is still limited improvement in terms of the usability of web search UIs for elderly users. Therefore, our main objective is to design and evaluate a web search UI model application compared with the most used web search UI: Google interface [24]. The addressable objectives in this study are listed as follows:

1. To design an adaptable web search model for the elderly.
2. To design a web search UI prototype based on Objective 1.
3. To use measurements such as (i) time on task, (ii) error rate, and (iii) subjective satisfaction (System Usability Scale Questionnaire (SUS)) for comparison between the web search UI and the Google web search UI prototypes to evaluate their usability for the elderly users.

The findings of this study will provide guidance to managers and designers of online apps on how to create web search applications that are both usable and meet users' criteria and demands, which will be identified in this study. Other design re-searchers in the HCI community will be interested in this study's primary contribution, which was to create an adaptable web search UI model appropriate for elderly users.

The remainder of this paper is organized as follows. Section 2 reviews the related work of the web search user interfaces for the elderly. In Section 3, we address the methodology. In Section 4, we present the results and data analysis. In Section 5, we introduce the conclusion, limitations and future work. Section 6 presents an acknowledgement.

## 2. A Related Work

A large percentage of developing a website or any other computing system in-volves designing the user interface [25, 26]. The search user interfaces for elderly people should prioritize their inability and usability issues. Therefore, it should cater their preferences to make it more user-friendly and compatible for their personal needs. There are currently various studies that emphasized a dedicated web search design UI for the elderly.

In specific, Sanchiz et al. [2] developed a supporter tool. This tool was designed to examine how it could assist seniors in setting more effective search objectives. The supporter tool must recall the previous query and show how the information on the page is related to the query. To find a solution for cognitive issues, it also examines the behavior of elderly people with various complex search problems. Therefore, the relationship between age and tool was synthesized to facilitate elderly user search for a better outcome.

Van Oostendorp et al. [27] devised a solution because the elderly took significantly longer than younger participants to finish the entire search task, even though the task is relatively simple. Based on individual task analysis, elderly people were observed to take significantly more time than younger people in reviewing Search Engine Results Pages (SERPs) for each simple task and significantly less time than younger people en-gaging in more difficult tasks on websites. The accuracy obtained for more difficult tasks was significantly lower when compared to simpler tasks. Consequently, com-pared to younger users, older users' search results were much less accurate.

Abegaz et al. [28] suggested creating a prototype for the search engine using four different interfaces. Three of them used color and shape-based visual elements. There were three types of visual stimuli: low positive, strong positive, and neutral. The names of the interfaces were wCloud, sCloud, and wsCloud. Here, Bing was being used as the default interface. The wCloud interface used text formatting, such as text color. Low, high, and neutral mood states were produced by the colors red, blue, and black, respectively. The sCloud interface uses polygons to produce visual interest. The degrees of stimuli were designed like polygons in which there were angular, mixed, or round in order to elicit low positive, neutral, and high positive moods. Color and shape were combined in the wsCloud interface to provide visual cues. This study suggests that adding color and shapes to search engines could improve the effectiveness of senior citizens' web searches.

Aideen et al. [29] implemented system tools in search engines to assist elderly users in their search tasks. In this study, users should be instructed and encouraged to use various search techniques to produce interesting results when looking for information online. The system tools used in this research did not produce search success for either of the age groups.

Aula et al. [30] established a web search user interface named Etsin, specifically for elderly people. Etsin can acknowledge Word, PowerPoint, Excel, and PDF files and recommends the appropriate icon for the elderly to click on. Since Etsin only offers relevant and important information, the interface generally felt simpler for elderly users than Google, even for those familiar with Google. Google, on the other hand, offers a ton of unrelated results that have nothing to do with the current search, and it uses disorienting colors such as black, blue, bold, and green.

Kaki et al. [3] claim that more results from the search engine must be retrieved for good results, which increases time and cost. The author designed a Findex system that displays a list of the frequently used words and phrases as result categories next to the actual results in an overview display. The results list showed only the category (word or phrase) that was selected. When users evaluate the first-fetched results, only ten of the many results that Findex computes are displayed; the remaining results are computed in the background. Hence, Findex can provide the desired number of results at a lower price, but there is a delay in getting them.

According to the literature, it was discovered the majority of prior studies focused only on adding tools to existing web search UIs to help the elderly improve their user performance in online searching [2, 3, 27, 29]. The rest of the prior research studies developed a search interface for the elderly [28, 30]. In addition, there were some limitations in the studies from an academic point of view, such as not involving a sufficient number of participants in the study. However, they were limited to investigating and resolving a specific problem in the search interface. Furthermore, since most of the studies were conducted before 2008, they lacked the benefits of contemporary web design tools, such as searching using images and voice. Many of the presented improvements still have their limitations, despite the fact that the majority of the concepts focused on by the reviewed papers are quite helpful and realistic for elderly users to improve their daily Internet search activities. Based on our analyses, no previous studies have clearly designed a web search UI based on an adaptable UI design for elderly users. Therefore, search performance and satisfaction can be improved by creating a new adaptable web search UI model for the elderly.

## 3. Methodology

This study followed a user-centered design methodology with two phases: design and development, and comparative usability evaluation. The design phase involved setting clear objectives, conducting user research, and performing task analysis. The UI design prioritized simplicity, clarity, and ease of use through large fonts, intuitive icons, and minimalistic layouts. In the iterative prototyping and testing phase, low-fidelity and high-fidelity prototypes were tested with elderly users, collecting feedback. The evaluation phase included comparative usability evaluation and user feedback to measure time on task, error rate, and user satisfaction. This methodology aimed to create an accessible and user-friendly web search UI for elderly users.

### 3.1 Design and Development

The adaptable web search UI model for elderly was devised and developed based on our previous studies [31,32] and our previous studies covered the behavior of the elderly during their interactions using the current web interfaces and identified the usability issues faced by them [31, 32]. **Fig. 1**. Shows the methodology of design and evaluation of web search UI model for elderly.

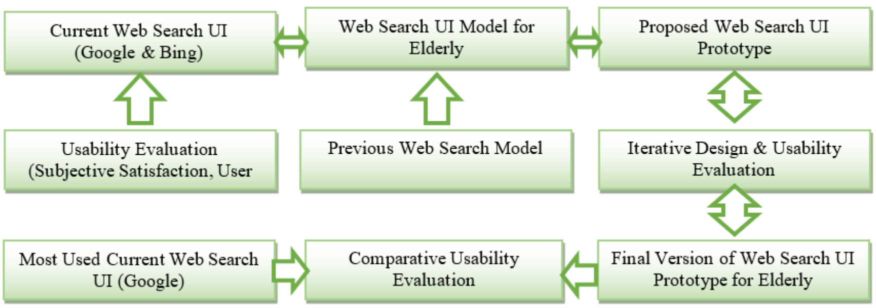



**Fig. 1.** Design and evaluation of web search UI model for elderly

The User-Centered Design (UCD) method is generally preferred because it emphasizes the end-users first and demonstrates improved efficiency and usability across a wide range of websites and applications [34, 35]. The web search UI prototype should offer a platform to make it easier for elderly users to conduct internet searches. Therefore, beginning the web design and development processes with a user-centered perspective is crucial as it can enable the end user to decide and confirm key elements of the web search experience.

Upon outcome analysis, the requirements and modifications necessary were resolved and coded into the development of a high-fidelity prototype using React JavaScript, JavaScript, and Cascading Style Sheets (CSS). In this case, the editor selected is Visual Studio Code. In addition, the web search UI prototype was connected to the Google Custom Search API. The

selection of this tool is justified for the following reasons. A comparison between the proposed web search UI and the Google interface will be provided based on a realistic usability test that will be carried out on the participants. For instance, it enables websites and applications to programmatically retrieve and display search results from Programmable Search Engines.
Furthermore, the web search UI prototype provides the participants with a sense of interaction during the conduct of actual main tasks. Hence, providing a genuine and precise reaction on the information provided. In particular, the environment of React JS, JavaScript and CSS with Visual studio code helps in the creation of useful web interface solutions that are faster and more interactive.

### 3.2 Comparative Usability Evaluation

The comparative usability evaluation was carried out after the final prototype had been evaluated and built. The experiment used a within-group design to compare the two-web search UIs among the same group of participants. The order of presentation of the two web search UI versions was chosen at random. In this usability test, 20 participants participated in a comparative usability evaluation, which compared the proposed model of web search UI to the currently most popular web search interface, the Google interface [24]. This was accomplished using the following methods: (i) time on task, (ii) error rate, and (iii) subjective satisfaction (SUS Questionnaire). Ultimately, these measurements aimed to identify the usability of the web search UI model compared to measurements of the most used web search interface, the Google interface.

#### 3.2.1 Experimental Setup and Procedures

Prior to the start of the usability testing, the participants were all briefed and presented with the aim of our study to obtain information necessary in terms of interface efficiency. They were also instructed not to worry if they encountered difficulty with a particular task during the testing session; preferably, they should notify the moderator/observer to pass that specific task and jump to another one. Besides, the participants were assured that the search engine would revert any information consisting of information they provided. The participants agreed to take part in the test and record and report their results, particularly for the study, by signing a paper before the test began. The user's interactions with the interface were also captured through computer screen recordings.
As shown in **Table 1**, a set of eight tasks covering the functionalities of the key search interface elements was given to each participant. Additionally, they were told to complete these activities while utilizing the search UI prototype and Google. While the other participants began by utilizing the proposed web search UI model, half began using the Google UI. Due to the pandemic (Covid-19), each usability test was carried out at a different time and location using a computer. Safety precautions were not taken lightly in this case.
The usability test took 20 to 30 minutes. Observers were engaged during the session to record how the participants responded to the search UI. The participants were given a SUS questionnaire with a set of questions related to the search UI, once they completed all the activities. This is performed to evaluate their satisfaction with the interface used [36], which was evaluated on a scale of 1 to 5. The questions specifically covered how people generally felt about using the search UI.

**Table 1.** Tasks and their descriptions

| Task # | Task | Task Description |
|---|---|---|
| 1 | You would like to use search by text to find the name of a person. | Find who is Malaysia's current health minister |
| 2 | You would like to save search results to browse later. | Save the result of the official UTM website. |
| 3 | You would like to search by voice to find the name of the official website. | Find the official website of UTM |
| 4 | You would like to open a result and then go back to the main search results page. | Open the official website of UTM and then go back to the main search results page. |
| 5 | You would like to search by image to find a related image | Find related images for UTM images or any image you would like to see. |
| 6 | You would like to look at your search history. | Go to the history and find the last visited and opened result. |
| 7 | You would like to find a saved result at bookmarks. | Find the result that you saved. |
| 8 | You would like to change your account setting pages such as font size, font type, password or contact number. | Find the settings page and change your font type. |

### 3.2.2 Participants

Nielsen and Landauer, who had previously argued that the optimal number was five, stated in a classic paper that the number that works best varies on the size of the project, with seven participants as ideal for small projects and 15 participants for medium-to-large projects [37]. However, they pointed out that while conducting usability testing with 3.2 participants, the benefits to costs ratio is at its highest [37]. In this study, for the usability testing, by using a within-group design, one group of 20 participants was recruited [37, 38]. In addition, all participants were aged 60 or older in accordance with the World Health Organization [38].

### 3.2.3 Apparatus

The study is conducted using a laptop (Lenovo Intl Core i5) configured with a 14”-inch screen HD 1920 x 1080 Touchscreen Monitor and 16GB Random Access Memory (RAM) for all tests. The Figma software tool was used to design the low-fidelity prototype. On the other hand, React JS, JavaScript, and CSS were used to develop the high-fidelity prototype. The whole prototype design will not be completed without the editor tool, Visual Studio Code.

## 4. Results and Data Analysis

### 4.1 Design and Development Results

Our previous studies covered the behavior of the elderly during their interactions using the current web interfaces and identified the usability issues faced by them [31, 32]. In terms of usability, it was discovered that a straightforward design usually makes the search process for elderly people less challenging and more controllable based on both interfaces of Google and Bing [31, 32]. Most participants also noted that the various colors of search interfaces gave the impression that they were cluttered and complicated. For a better adaptable web search engine interface for older people, it is advisable for colors to be utilized sparingly. Elderly users benefit from simple interfaces and result pages because they feel more in charge of the situation; this helps them feel less frustrated by problems brought on by a lack of knowledge. For example, it is advised to add a "clear text box query " button to prevent confusion while using the Backspace and Delete buttons. Additionally, there is a variety of needs among elderly users. Interfaces should be customized and flexible for each user to meet their specific needs. The improved web search UI's objective is to give the elderly a more acceptable option for utilizing a basic search engine; rather than replace a more complex interface, this is an adaptable UI which is easy to use on a daily basis. Additionally, this might help older people overcome their limited cognitive, physical and intellectual abilities.

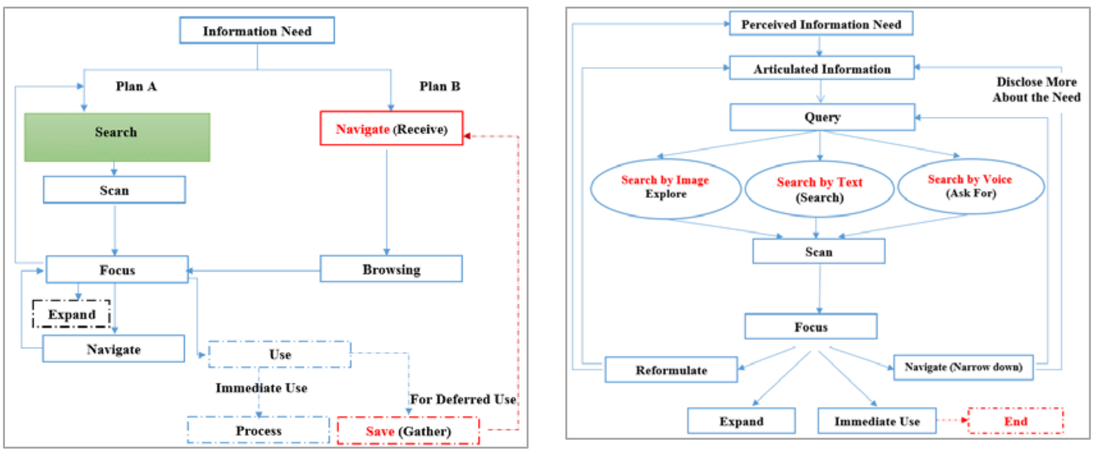
The information gathered during previous studies served as the foundation for the proposed elderly web search UI model. Therefore, the model is designed to address the research objectives. The elderly community can use most general-purpose information-seeking models. However, these models either cover only a portion of the information-seeking behavior of this community or are too general to offer useful insights.

This model uses current models in information searching, information seeking, and information behavior in order to create a new web search UI model for the elderly based on Sadeh's model [39]. For the benefit of academics and researchers, particularly the scientific community, the Sadeh model was developed. The selection of Sadeh's model was justified as follows:

1. It explains in detail the steps (stages) users can take for information searching and system interaction.
2. This model can be used in a wide range of contexts, roles, tasks, and knowledge fields.
3. It is in line with the emphasis of the existing study, which placed a user-centered strategy above a system-based one.
4. This model prioritizes the requirements, experiences, and other elements that users encounter when information searching and system interaction.
5. The development of this model included several senior academics, which addresses our main concern for the elderly community.

The following explains how the identified steps also represent the stages of the web search model and the differences with sadeh's model were highlighted in red color. **Fig. 2** (a) depicts the web search model for the elderly, while **Fig. 2** (b) depicts the search action.

This model categorizes two active information-seeking processes, which are search and




(a) (b)

**Fig. 2.** The web search model(a) and web search model-Search Action (b).

navigation. Search is the process of searching for information using one of three search methods (text, voice, or image), while navigation is the process of moving between saved information lists in a web search interface and browsing. The model presents information seeking as a more general activity that includes information searching as a directed process. When a seeker recognizes a desire for knowledge, the search process starts immediately. The seeker is aware of the type of information needed. The information seekers should switch and specify their information needs in order to query the information system. The search could be based on the seeker's presumptions about the metadata of the interface's bookmarker lists or the keywords provided in the information.

The undirected process "Navigation" starts with a navigation action. Then, the seeker obtains a list, whether from saved information topic lists in interface menus, such as bookmarked lists, or search history through a web search interface. Seekers can use the list to navigate to other topics that might be interesting for them and exit the webpage during navigating.

The users proceed to the next action, which is browsing. In this part, they investigate the topics on the list and often, they would want to investigate a topic thoroughly before focusing on it. The focal point of the action is the interconnection of directed "Searching" and undirected "Navigate" information seeking. Researchers may want to view the currently selected webpage when they concentrate on a web topic in order to further investigate it and analyze more information.

Accordingly, the user has the option to either view the webpage immediately or save it for later use ("Save it in the bookmarked list"). The user can navigate to different web pages by clicking links or the bookmarked and history lists. When navigating, the seeker concentrates on a single webpage topic at a time. The procedure is repeated, and the seeker has the option to either carry on exploring or start a new search at any time. A seeker may choose to launch a search for another webpage or an intriguing subject discussed in the main webpage or result. This will almost certainly involve the seeker using a different approach to information search. The search query can be categorized into three groups based on the method used to achieve the information needed: text, voice, or image search.

- By text: When the seeker searches for information by typing a text query.
- By voice: When the seeker searches for information by voice.
- By image: When the seeker searches for information by inserting an image.

System settings affect each of the three search options (text, voice, and image). Most users typically scan the top items in a results list before taking any action. One of the following options will be considered when they evaluate the first screen:

- Reformulate: the seeker should reformulate the query if a seeker does not find relevant information
- Focus: the seeker should focus on a specific item if the results are appropriate
- Narrow down: the seeker should shortlist the query list if there are too many results

The foundation of the proposed web search UI model is the web search model. The following categories of elderly web search applications can be found with adaptable web search user interfaces:

- Selection of content: The contents presentation to users in the user interface.
- Presentation of information: All information in the interface is shown visually
- Navigation concepts: Users navigate via the user interface to gather the desired information on the webpages.

The positions of various web search UI components should be fixed to establish a consistent design across various variations. There are seven major sections: a help section, a profile section, a history section menu, a menu for various categories of bookmarked results, elements for keyword search, searching methods, and a history menu for navigation. The search input consists of voice, image, text, bookmarked, and history menu navigational elements to give older users quick access to saved results. Instead of spending time and energy researching the same information, the elderly can save both by using the menu.

Based on the UCD process, the web search UI model was implemented to provide an iterative process for developing the suggested prototype with an increasing number of users involved in the experimental procedure. The user test was then performed to ensure that the web search UI model was designed and developed according to the requirements and needs of additional users. The web search UI model was adjusted with adequate changes to meet the users' requirements after receiving feedback from users who participated in the design. Following that, the web search UI model was ready for conducting usability testing. The end result is a more realistic user interface design for the elderly community. **Table 2** presents the web search UI model's elements with their description and **Fig. 3** and **Fig. 4** below are the screenshots of the web search UI prototype.

**Table 2.** The proposed design solutions aligned with the identified usability issues

| Element | Description |
|---|---|
| Homepage button | **Adding a large-sized homepage button** improves UX and Quick access features, reducing web browsing steps between the main search page and others. This is beneficial even if it is considered a simple modification. |
| Username label | **Adding a large user name label** improves UX and displays a personalized search interface to users to assist them in recognizing their interface account. |
| Profile image | **Adding a large profile image** improves UX and helps people with memory issues identify their account web page. |
| Text box | **Enlarging the text box makes** the query text visible so that it can be modified. |
| Search button | **Enlarging the size of the search button** makes it easier to notice and click on. |
| Voice search button | **Placing the voice research button next to the main search button** emphasizes its importance and makes it easy to navigate and use. |
| Image search button | **Locating the search button** by the image means users can access it without having to navigate to different pages. It is located next to the voice search button because of its importance in the sequence. |
| Clean button | **A quick clean feature** was introduced to save time deleting the query text using a keyboard; hence the clear button was created, and because of its importance sequentially, it is located next to the search button by image. |
| Keywords | **The quick keyword feature** allows elderly users to use it without typing it, which saves time, reduces memory load, and improves cognitive ability. These keywords were chosen based on previous research on the most frequently searched topics by elderly users on the Internet. Furthermore, the search engine database update can be used to update the results of these queries. |
| Topics list menu | **This contains a list of different names** that the user organizes, allowing him/her to save results within each list according to the topics of the list. This allows users to return to the results whenever they need to, in addition to the presence of the deletion and modification features in the results and lists, as well as the names of the current lists. The benefit of this is that it reduces navigation steps and memory load because the user can easily access the information. |

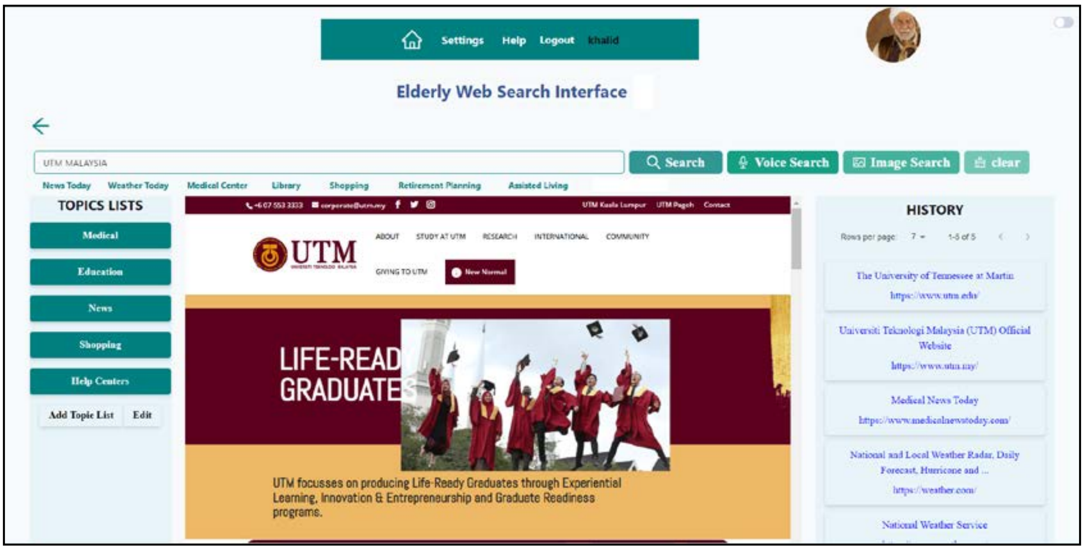



**Fig. 3.** Viewing the research result by using Iframe in the homepage

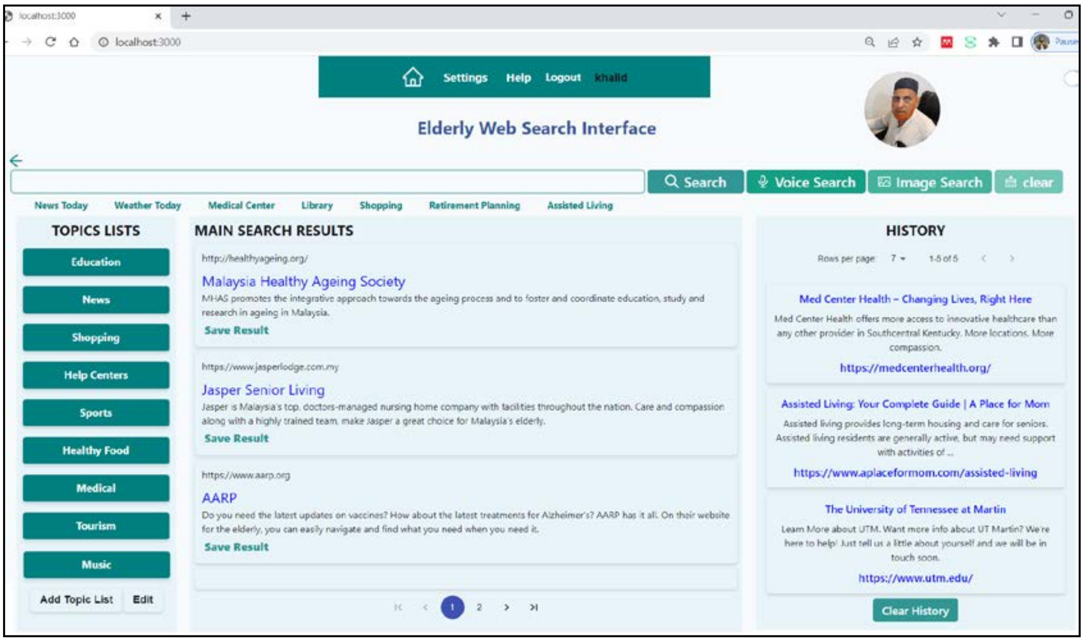



**Fig. 4.** The structure of the web search UI prototype homepage

## 4.2 Comparative Usability Evaluation Results

This section describes an analysis of the results of the usability testing process in terms of effectiveness, efficiency, and user satisfaction. These factors are further evaluated to measure the effectiveness of the web interface using performance measurement techniques, emphasizing the number of errors made by participants. These errors were counted from screen recordings. The efficiency of the interface was measured by determining the average completion time for an individual task that was calculated during screen recordings. Similarly, the level of user satisfaction was measured by reviewing the findings of the SUS respondents' question summary.

### 4.2.1 The Participants' Characteristics

Each of the 20 participants was given an amount of compensation for participating in the evaluation. The participants were recruited from public locations such as mosques and malls and from personal contacts. A form, including demographic details and inquiries about participants' Internet search experiences, was supplied to the study participants. The information recorded included participants' age, gender, nationality, morbidity and educational background. **Table 3** displays the characteristics of the participants.

**Table 3.** The participants' information

| Demographic | Category | Number | Percentage |
|---|---|---|---|
| Age | 60 to 64 | 12 | 60% |
| | 65 to 69 | 7 | 35% |
| | 70 to 74 | 1 | 5% |
| Gender | Male | 16 | 80% |
| | Female | 4 | 20% |
| Education | Middle school | 0 | 0% |
| | High school | 5 | 25% |
| | College | 6 | 30% |
| | Graduate degree | 9 | 45% |
| Internet Search Experience. | Less than 1 year | 0 | 0% |
| | 1 to 2 | 0 | 0% |
| | 3 to 5 | 5 | 25% |
| | 6 to 10 | 7 | 35% |
| | More than 10 years | 8 | 40% |
| Nationality | Malaysian | 4 | 20% |
| | Libyan | 8 | 40% |
| | Yemeni | 6 | 30% |
| | Egyptian | 2 | 10% |
| Morbidity | Visual impairment | 12 | 60% |
| | Diabetes | 8 | 40% |
| | Mobility disability | 0 | 0% |

### 4.2.2 Subjective Satisfaction

During the usability testing of both web search interfaces, 20 random users participated by using the two web search UIs (the web search UI prototype and Google web UI). The experimented using eight different tasks on both interfaces prior to the completion of the ten-item SUS questionnaire. The individual scores of SUS for each interface are recorded as in **Table 4**.

**Table 4.** The pairs of system usability scale scores of Google and web search UI

| Participants# | Web Search UI Prototype | Google Interface |
|---|---|---|
| 1 | 92.5 | 65 |
| 2 | 95 | 62.5 |
| 3 | 95 | 60 |

| | | |
|---|---|---|
| 4 | 97.5 | 62.5 |
| 5 | 80 | 72.5 |
| 6 | 97.5 | 90 |
| 7 | 97.5 | 70 |
| 8 | 80 | 67.5 |
| 9 | 92.5 | 60 |
| 10 | 97.5 | 67.5 |
| 11 | 70 | 70 |
| 12 | 80 | 52.5 |
| 13 | 77.5 | 65 |
| 14 | 95 | 72.5 |
| 15 | 97.5 | 70 |
| 16 | 97.5 | 65 |
| 17 | 97.5 | 65 |
| 18 | 97.5 | 60 |
| 19 | 77.5 | 50 |
| 20 | 90 | 57.5 |
| Average | 90.25 | 65.25 |

The SUS mark for the Google Interface was 65.25, lower than the average of 68, and the SUS mark for the web search UI prototype was 90.25, higher than the average of 68.
In reference to the score analysis suggested by Bangor et al. in 2009, the usability of the web search UI prototype is indicated as "Best Imaginable", and the usability of the Google Interface is indicated as "Ok". Refer **Fig. 5** below [40]. Based on this analysis, the usability level is considered difficult. However, it does not necessarily mean that the interface usability should be considered poor.

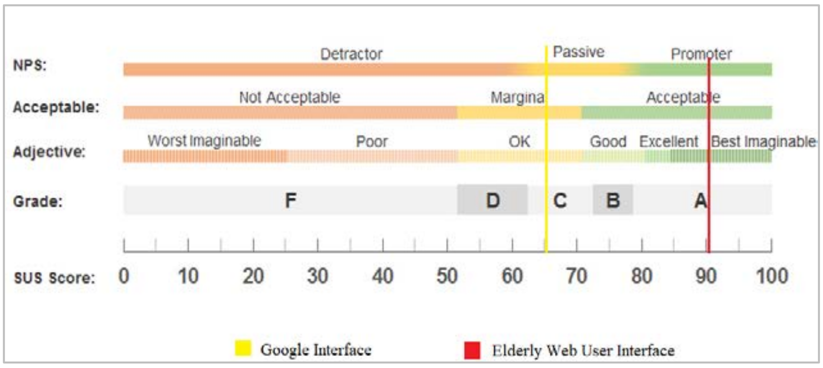



**Fig. 5.** The SUS score mapping of interpretation diagram by Bangor et al. (2009)

In 2009, Lewis and Sauro calculated learnability individually, based on usability as the second aspect of SUS [41]. Learnability = 12.5 * (item 10 + item 4), Usability = 3.125 * sum of Item (1,2,3,5,6,7,8,9). This is summarized in **Table 5**.

**Table 5.** The average of pairs of SUS scores, usability, and learnability

| Measurement | SUS | Usability | Learnability |
|---|---|---|---|
| Web Search UI Prototype | 90.25 | 90.625 | 88.75 |
| Google Interface | 65.25 | 68.25 | 63.75 |

Based on the gathered data, the web search UI prototype had a learnability score of 88.75, while the Google UI scored 63.75; these are remarkably lower than the usability score for both interfaces (90.625 and 68.25 respectively, as shown in **Fig. 6** So, the usability level for the web search UI prototype is higher than the learnability level and was scored as "Best Imaginable". However, the Google interface was ranked as 68,25 and nearly "Good". This supports our finding that the aspects that can influence usability during the design process must be highly considered. During the design and development phase of the web search UI prototype, more consideration was dedicated to the variables that affected usability.

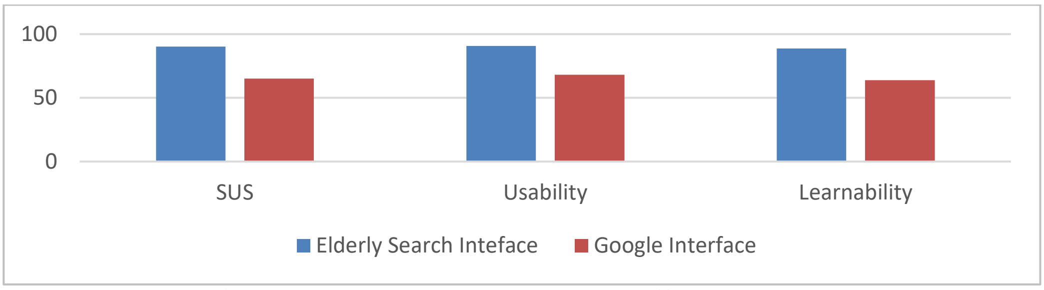



**Fig. 6.** Google interface and the web search UI prototype: differences in their SUS, usability and learnability

Based on **Fig. 6**, it can be acknowledged that the usability score of the web search UI prototype is higher than the Google interface, with a mean value of 90.625 and 68.25, respectively. This demonstrates that the web search UI prototype is more user-friendly for elderly people than the Google interface.

### 4.2.3 Task Completion Time

The overall task completion times for the 20 participants involved are reported in Appendix L for both interfaces. To be fair, all participants were subjected to the same conditions to complete the tasks. The only difference was that each participant started with a different interface. For example, half of the participants started using the Google interface, while others started using the web search UI prototype for usability testing. **Table 6** shows the total task completion time, whereas **Fig. 7** depicts the performance of the total task completion time for each task.

**Table 6.** The task completion times across tasks

| Tasks | Web Search UI Prototype | Google Interface |
|---|---|---|
| Task 1 | 940 | 1244 |
| Task 2 | 769 | 927 |
| Task 3 | 892 | 837 |
| Task 4 | 239 | 259 |
| Task 5 | 675 | 1050 |
| Task 6 | 274 | 831 |
| Task 7 | 289 | 690 |
| Task 8 | 606 | 944 |

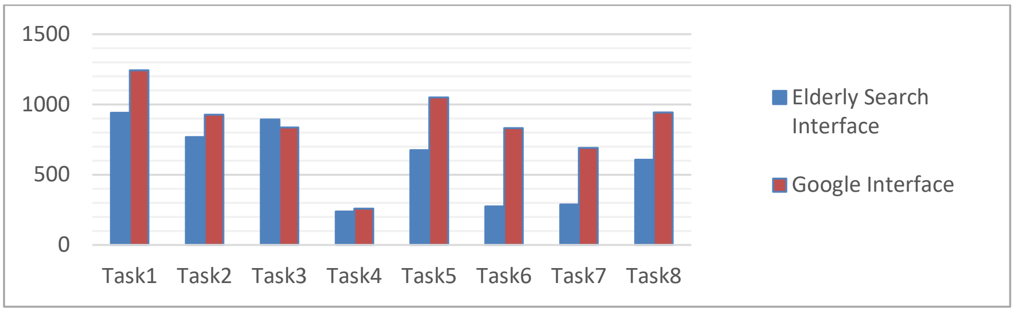



**Fig. 7.** The participants' task completion times across tasks

### 4.2.4 Error Rate

The number of errors made during the interaction between both interfaces was counted individually. **Table 7** shows the total number of errors made by participants in each task during each interaction with Google and the web search UI prototype and **Fig. 8** shows the error made by the participants across tasks.

**Table 7.** The total number of errors made by the participants in each task

| Tasks | Web Search UI Prototype | Google Interface |
|---|---|---|
| Task 1 | 4 | 5 |
| Task 2 | 3 | 23 |
| Task 3 | 21 | 20 |
| Task 4 | 2 | 2 |
| Task 5 | 8 | 39 |
| Task 6 | 6 | 18 |
| Task 7 | 7 | 22 |
| Task 8 | 3 | 37 |

**Fig. 8** presents the overall performance data of errors made by the participants for all tasks for both interfaces. Based on **Fig. 8**, the participants made the most errors using the Google interface for completing Task 5, Task 8 and Task 7, respectively. On the other hand, the participants made the most errors using the web search UI prototype for completing Task 3, followed by Task 5. However, the participants made fewer errors in completing Task 4 for both interfaces. It was observed that participants were able to perform satisfactorily using the web search UI prototype compared to the Google interface.

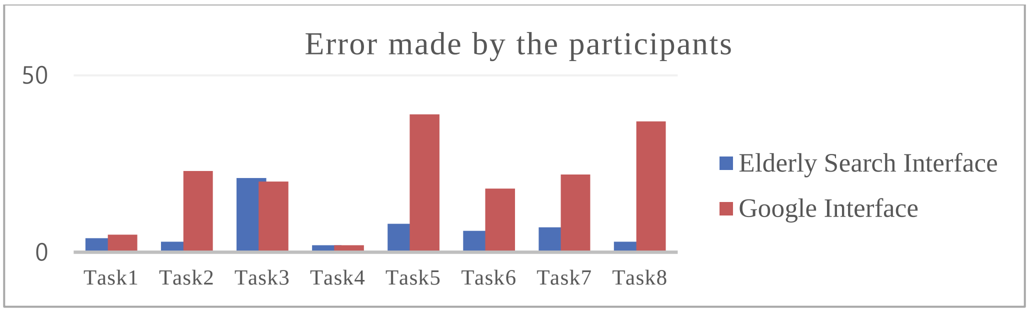



**Fig. 8.** The error made by the participants across tasks

The paired t-test, sometimes referred to as the paired-samples t-test, in contrast to the two related groups that there are statistically significant differences between them [37]. Below is a presentation of the paired-sample t-test results from SPSS for each measurement. In addition, the Wilcoxon test was carried out to determine the difference between Google and the web search UI prototype in terms of subjective satisfaction and search performance with both interfaces.
Furthermore, comparative statistical tests were conducted based on independent and dependent variables to determine the differences between the web search UI prototype and the Google interface in terms of search performance and subjective satisfaction. The tested null hypotheses were listed as follows:

- H1: There is no difference in subjective satisfaction between using the web search UI prototype and the Google interface
- H2: There is no difference in the user's task completion time between using the web search UI prototype and the Google interface
- H3: There is no difference in the elderly user's error rate between the web search UI prototype and the Google interface

### 4.3.1 Subjective Satisfaction

**Table 8** summaries the comparison results between the web search UI prototype and Google Interface in relation to participants' subjective satisfaction. In this study, the p-value is < 0 .05. This value is considered too small, indicating that there is less than one in a billion chance that the mean of SUS scores is equal. It can also be concluded that the certainty that the Google interface and the web search UI prototype would have different SUS scores is over 99.999%. The interface of the Google SUS score was 65.25, which was less than the web search UI prototype of 90.25. Moreover, the web search UI prototype showed a lower standard mean error rate of 2.67261 than the Google interface (13.09094). Therefore, the results demonstrated a significant difference in subjective satisfaction between the Google interface and the web search UI prototype (H1). Hence, it can be asserted that elderly users perceived the use of the web search UI prototype as simpler and easier compared to the Google interface.

**Table 8.** The pair sample t-test for subjective satisfaction

| Subjective Satisfaction | Web Search UI Prototype | Google Interface |
|---|---|---|
| Mean | 90.2500 | 66.0125 |
| S.D. | 9.02846 | 7.62461 |
| t-value | 0.071 | |
| df | 19 | |
| 2-tailed sig. | 0.0000 | |

### 4.3.2 Task Completion Time

**Table 9** presents the overall task completion time, comparing results between the web search UI prototype and the Google Interface. The findings revealed a considerable difference in the overall time required to perform activities between the Google interface and the web search UI prototype (H2).

**Table 9.** The pair sample t-test for task completion time

| The Total Task Completion Time | Web Search UI Prototype | Google Interface |
|---|---|---|
| Mean | 234.20 | 339.10 |
| S.D. | 76.729 | 91.850 |
| t-value | 4.029 | |
| df | 19 | |
| 2-tailed sig. | 0.001 | |

### 4.3.3 Errors Made by the Participants

**Table 10** presents the overall results of comparing the total number of errors made by the participants between the online search UI prototype and the Google Interface. The results revealed a substantial difference between the Google interface and the online search UI prototype in the total number of errors made to accomplish tasks (H3).

**Table 10.** The pair sample t-test for the total number of errors

| Total number of errors across tasks | Web Search UI Prototype | Google Interface |
|---|---|---|
| Mean | 2.70 | 8.30 |
| S.D. | 3.079 | 3.246 |
| t-value | 6.002 | |
| df | 19 | |
| 2-tailed sig. | 0.000 | |

### 4.3.4 Test for Significance

In addition to using the within-subject design, the Wilcoxon matched-pairs signed-ranks test was applied as a non-parametric test used since the sample size of 20 participants was small to determine whether there were differences between the two interfaces design in terms of the participants' satisfaction and search performance [37]. The Wilcoxon test was carried out to determine the difference between Google and the web search UI prototype in terms of subjective satisfaction and search performance with both interfaces.

In this study, the results reveal that the significance level in comparing the differences in search performance and subjective satisfaction is lower than the 0.05 confidence level. The t-value, a negative Z value, and a corresponding p-value of <0.05 indicates a significant difference in terms of search performance and subjective satisfaction between the web search UI prototype and the Google interface. This statistic implies that the H1, H2, and H3 are rejected, respectively.

The results showed that 19 cases were negatively signed, and zero case was positively signed after ranking. However, there was one case in which the ranking was tied. It seems clear that the Google SUS scores tend to have lower values than the web search UI prototype scores. This was proven when the study of subjective satisfaction showed a significant difference in subjective satisfaction between the web search UI prototype [M=90.2500, SD=9.02846] and Google interface [M=66.0125, SD=7.62461], t (19) = 0.071, p=0.000 and the Z value is -3.840b, which has a two-tailed probability of p < .000. This means that the differences between

participants' subjective satisfaction with the SUS scores of Google interface and the web search UI prototype was significant at 5% level. Thus, the null hypothesis (H1) is rejected.
The comparison of the task completion time performance showed that there was a significant difference in average of task completion time performance between using the web search UI prototype [M=29.4000, SD=9.54987] and the Google interface [M=42.4500, SD=11.50046, t (19) = 4.007, p=0.001]. Therefore, the participants needed significantly lesser time to complete the whole search tasks when they were using the web search UI prototype.
Subsequently, the comparison between using both interfaces in search performance showed that there was a significant difference in the total number of errors during each task's performance between the web search UI prototype [M=2.70, SD=3.079] and Google interface [M=8.30, SD=3,246 t (19) =6.002, p=0.000]. However, the participants made significantly fewer errors in completing tasks when they used the web search UI prototype. This is due to the web search UI prototype that helps participants develop gross motor processing skills; therefore, participants can attentively perform the search tasks eventually reducing errors in completing the tasks.

## 5. Conclusion, Limitations and Future Work

This study designed the adaptable web search UI model for elderly users; it also compares performance and satisfaction between the adaptable web search UI model and the Google interface perceived by the elderly users. Although overall search performance was "OK" for the Google interface and "Best Imaginable" for the elderly interface, elderly users were able to complete simple tasks without having difficulties in both interfaces. On the other hand, there were some tasks that were found to be difficult for even the most experienced users using the Google interface. These tasks were Task 5 and Task 8. While interacting with the Google interface, elderly users performed particularly poorly in changing interface settings and searching by image. The test findings revealed considerable differences in user satisfaction, completion time, and errors between the adaptable web search UI model and the Google interface. During the evaluation, the activity of the participants was monitored by the observer. The observer noticed that users performed exceptionally well using the adaptable web search UI prototype compared to the Google interface. Although the participants were unfamiliar with the web search UI prototype and needed additional time to learn how to utilize it, they did well on all tests. As a result, the subjective satisfaction with the Google interface, which was below 68, failed to pass the acceptable average [40]. Overall, most of the participants were convinced that the elderly interface was easier to use.
In conclusion, this research has demonstrated an adaptable web search UI model for elderly users. The interface successfully provides more suitable and usable interaction as well as navigation for elderly users compared to the Google search UI. In other words, the main objective of this research has been successfully accomplished. Thus, a comprehensive analysis has been provided to justify the usability improvements of the adaptable web search UI model. The experiments set up in this research were limited to a laptop. Therefore, it is further recommended that future work should be conducted with different setups, using devices such as notebooks, smartphones and tablets, as there are certain elderly users who favor the use of these devices instead. To further our understanding of users' online search performance, it is also advised that we consider the various backgrounds of the participants and look into more complex user interactions. It may be beneficial to explore the uncharted territory in this research field because increasing levels of difficulty may hinder elderly users' ability to navigate and search online. To increase the effectiveness and subjective satisfaction of users'

online searches, future work can be expanded from one of the unidentified parameters that will test or enhance the current research.

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## References

[1] A. Dommes, A. Chevalier and S. Lia, "The role of cognitive flexibility and vocabulary abilities of younger and older users in searching for information on the web," *Applied Cognitive Psychology*, vol. 25, no. 5, pp. 717-726, 2011. Article (CrossRef Link)

[2] M. Sanchiz, F. Amadieu, P.-V. Paubel and A. Chevalier, "User-friendly search interface for older adults: supporting search goal refreshing in working memory to improve information search strategies," *Behaviour & Information Technology*, vol. 39, no. 10, pp. 1094-1109, 2020. Article (CrossRef Link)

[3] M. Käki and A. Aula, "Findex: improving search result use through automatic filtering categories," *Interacting with Computers*, vol. 17, no. 2, pp. 187-206, 2005. Article (CrossRef Link)

[4] A. Aula, "User study on older adults use of the Web and search engines," *Universal Access in the Information Society*, vol. 4, no. 1, pp. 67-81, 2005. Article (CrossRef Link)

[5] S. J. Czaja, J. Sharit, R. Ownby, D. L. Roth and S. Nair, "Examining age differences in performance of a complex information search and retrieval task," *Psychology and Aging*, vol. 16, no. 4, pp. 564-579, 2001. Article (CrossRef Link)

[6] C. Hölscher and G. Strube, "Web search behavior of Internet experts and newbies," *Computer Networks*, vol. 33, no. 1-6, pp. 337-346, 2000. Article (CrossRef Link)

[7] Karanam and H. van Oostendorp, "Modeling individual differences in information search," in *Proc. of the 8th Indian Conference on Human Computer Interaction*, Mumbai, India, pp. 12-23, 2016. Article (CrossRef Link)

[8] S. Ranjana, F. F. Nah, K. Sharma, T. S. S. S. Katta, N. Pang et al., "Smart living for elderly: Design and human-computer interaction considerations," in *Proc. of 2nd International Conference on Human Aspects of IT for the Aged Population, Healthy and Active Aging*, Toronto, Canada, pp. 112-122, 2016. Article (CrossRef Link)

[9] L. Chaiwoo and J. F. Coughlin, "PERSPECTIVE: Older adults' adoption of technology: an integrated approach to identifying determinants and barriers," *Journal of Product Innovation Management*, vol. 32, no. 5, pp. 747-759, 2015. Article (CrossRef Link)

[10] C. Penny, L. Nikpour and H. D. Nowlin, "Aging well with smart technology," *Nursing Administration Quarterly*, vol. 29, no. 4, pp. 329-338, 2005. Article (CrossRef Link)

[11] M. F. Luca, A. J. Xavier, I. J. C. Schneider, L. R. Ramos, D. Sigulem et al., "Digital inclusion and functional capacity of older adults living in Florianópolis, Santa Catarina, Brazil (EpiFloripa 2009-2010)," *Revista Brasileira de Epidemiologia*, vol. 15, no. 1, pp. 106-122, 2012. Article (CrossRef Link)

[12] S. Xinran, W. Yan, H. Zhou, Z. Wang, X. Zhang et al., "Internet use and need for digital health technology among the elderly: a cross-sectional survey in China," *BMC Public Health*, vol. 20, no. 1, pp. 1-8, 2020. Article (CrossRef Link)

[13] W. Nicole, K. Hassanein and M. Head, "Computer use by older adults: A multi-disciplinary review," *Computers in Human Behavior*, vol. 26, no. 5, pp. 870-882, 2010. Article (CrossRef Link)

[14] G. Susan L. and S. H. Tak, "Computer, Internet and e-mail use among older adults: Benefits and barriers," *Educational Gerontology*, vol. 34, no. 9, pp. 800-811, 2008. Article (CrossRef Link)

[15] C. Sarah S., C. Lee, L. E. Stoeckel, A. Menke and C. C. Cowie, “Cognitive function among older adults with diabetes and prediabetes, NHANES 2011–2014,” *Diabetes Research and Clinical Practice*, vol. 178, p. 108939, 2021. Article (CrossRef Link)
[16] C. S. Lebech, E. T. Vestergaard and O. Hejlesen, “Muscle grip strength is associated to reduced pulmonary capacity in patients with diabetes,” *Primary care diabetes*, vol. 12, no. 1, pp.66-70, 2018. Article (CrossRef Link)
[17] M. Sanchiz, A. Chevalier and F. Amadieu, “How do older and young adults start searching for information? Impact of age, domain knowledge and problem complexity on the different steps of information searching,” *Computers in Human Behavior*, vol. 72, pp. 67-78, 2017. Article (CrossRef Link)
[18] A. Chevalier, A. Dommes and J. Marquié, “Strategy and accuracy during information search on the Web: Effects of age and complexity of the search questions,” *Computers in human behavio*, vol. 53, pp. 305-315, 2015. Article (CrossRef Link)
[19] J. Chin and W. T. Fu, “Interactive effects of age and interface differences on search strategies and performance,” in *Proc. of the SIGCHI Conference on Human Factors in Computing Systems*, Atlanta, Georgia, USA, pp. 403-412, 2010. Article (CrossRef Link)
[20] M. Sanchiz, J. Chin, A. Chevalier, W. T. Fu, F. Amadieu, et al., “Searching for information on the web: Impact of cognitive aging, prior domain knowledge and complexity of the search problems,” *Information Processing & Management*, vol. 53, pp. 281-294, 2017. Article (CrossRef Link)
[21] P. Gregor, A. F. Newell and M. Zajicek, “Designing for dynamic diversity: interfaces for older people,” in *Proc. of the Fifth International ACM Conference on Assistive Technologies*, Edinburgh, Scotland, pp. 151-156, 2002. Article (CrossRef Link)
[22] M. Zajicek, “Successful and available: interface design exemplars for older users,” *Interacting with Computers*, vol. 16, no. 3, pp. 411-430, 2004. Article (CrossRef Link)
[23] N. Jochems, S. Vetter and C. Schlick, “A comparative study of information input devices for aging computer users,” *Behaviour & Information Technology*, vol. 32, no. 9, pp. 902-919, 2013. Article (CrossRef Link)
[24] A. Chris, “Top 10 Search Engines In The World,” *In Reliable Soft*, 2022. [Online]. Available: https://www.reliablesoft.net/top-10-search-engines-in-the-world
[25] P. Turumugon and A. Baharum, “Identifying a user interface web design standard for higher learning institutions using Kansei engineering,” *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 11, no. 1, pp. 90-97, 2018. Article (CrossRef Link)
[26] B. Aslan and F. Y. Aslan, F. Y, “Examining the User Interface Development Stage in the Software Development Process,” *Avrupa Bilim ve Teknoloji Dergisi*, vol. 35, pp. 408-416, 2022. Article (CrossRef Link)
[27] H. Van Oostendorp and S. Karanam, “Supporting information search by older adults,” in *Proc. of the European Conference on Cognitive Ergonomics*, Nottingham, United Kingdom, pp. 1–8, 2016, Article No. 12. Article (CrossRef Link)
[28] T. Abegaz, E. C. Dillon Jr and J. E. Gilbert, “Investigating perceived usability and choice satisfaction of alternative search engine's presentation for older adults,” in *Proc. of the Human Factors and Ergonomics Society Annual Meeting*, Los Angeles, CA, Sage CA: SAGE Publications, vol. 59. No. 1, pp. 80-84, 2016. Article (CrossRef Link)
[29] A. J. Stronge, W. A. Rogers and A. D. Fisk, “Web-based information search and retrieval: Effects of strategy use and age on search success,” *Human Factors*, vol. 48, no. 3, pp. 434-446, 2006. Article (CrossRef Link)
[30] A. Aula and M. Käki, “Less is more in Web search interfaces for older adults,” *First Monday*, vol. 10, no. 7, pp. 1-10, 2005. Article (CrossRef Link)
[31] K. Krayz Allah, N. A. Ismail, L. Hasan and Y. L. Wong, “Usability Evaluation of Web Search User Interfaces from the Elderly Perspective,” *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 12, pp. 647-657, 2021. Article (CrossRef Link)

[32] K. Krayz Allah, N. A. Ismail and H. Elrobaa, “Empathy Map Instrument for Analyzing Human-Computer Interaction in Using Web Search UI by Elderly Users,” in *Proc. of International Congress of Advanced Technology and Engineering (ICOTEN)*, Taiz, Yemen, pp. 187-191, 2021. Article (CrossRef Link)
[33] E. Patsoule and P. Koutsabasis, “Redesigning websites for older adults: a case study,” *Behaviour & Information Technology*, vol. 33, no. 6, pp. 561-573, 2014. Article (CrossRef Link)
[34] E. R. Haines, A.Dopp, A. R. Lyon, H. O. Witteman, M. Bender et al., “Harmonizing evidence-based practice, implementation context, and implementation strategies with user-centered design: a case example in young adult cancer care,” *Implement Sci Commun*, vol. 2, no. 1, pp. 1-16, 2021. Article (CrossRef Link)
[35] C. M. Johnson, T. R. Johnson and J. Zhang, “A user-centered framework for redesigning health care interfaces,” *Journal of Biomedical Informatics*, vol. 38, no. 1, pp. 75-87, 2005. Article (CrossRef Link)
[36] J. Sauro and J. R. Lewis, “When designing usability questionnaires, does it hurt to be positive?,” in *Proc. of the SIGCHI Conference on Human Factors in Computing Systems*, Vancouver, BC, Canada, ACM, pp. 2215-2224, 2011. Article (CrossRef Link)
[37] J. Lazar, J. H. Feng and H. Hochheiser, “Usability Testing,” in *Research Methods in Human Computer Interaction*, 2st ed., 50 Hampshire Street, Cambridge, MA 02139, United States, Morgan Kaufmann is an Imprint of Elsevier, 2017, pp. 275-276. Article (CrossRef Link)
[38] World Health Organization, “Ageing and health,” *World Health Organization*, 2022. Article (CrossRef Link)
[39] T. Sadeh, “A model of scientists' information seeking and a user-interface design,” Ph.D. dissertation, City University London, UK, 2010. Article (CrossRef Link)
[40] A. Bangor, P. Kortum and J. Miller, “Determining what individual SUS scores mean: Adding an adjective rating scale,” *Journal of Usability Studies*, vol. 4, no. 3, pp. 114-123, 2009. Article (CrossRef Link)
[41] J. R. Lewis and J. Sauro, “The factor structure of the system usability scale,” *International Conference on Human Centered Design*, Springer, Berlin, Heidelberg, Springer, pp. 94-103, 2009. Article (CrossRef Link)

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