

# Empirical Design Guidelines for Enhanced Incorporation of Task Management in Web Browsing

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## Abstract

Task management features have become a necessity in web browsing, especially with the high proliferation of pages and information in the web. This paper presents a novel approach called TaskBar which helps manage pending tasks during web browsing. It works as a to-do list in the web browser and provides various task management features such as reminders and priorities to help decide which tasks should be dealt with first. A two-session controlled experiment was carried out to evaluate TaskBar and compare users' performance with and without task management features. The obtained data were analyzed in terms of task accomplishment time, rate of completion, and users' satisfaction. The results showed that incorporating task management features in web browsing, particularly TaskBar, significantly improved users' performance in terms of task completion time, completion rate, and satisfaction. These results were interpreted into a set of design guidelines for the employment of task management features in web browsers.

**Keywords:** Browser, Design, Guidelines, Revisit, Task Management, Web.

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## 1. INTRODUCTION

The importance of adopting task management in web browsers increases every day, especially with the vast growth of web pages and information in the web. The web browser has become the place where we perform many of our daily tasks such as flight booking and arranging a meeting. However, this dramatic change in using the web faces a relatively slow change in web browsers. For instance, bookmarks and history are still considered the main ways of saving web pages for later use. In addition, recent studies showed that users sometimes print and email themselves web pages for later use [1]. Many studies, as a result, have been carried out to investigate incorporating web browsers with task management features. Most of these studies focused mainly on augmenting bookmarks and other browser functionalities with reminding features, marking pages, and linking pages together. Pages in such approaches are usually grouped without a valid categorization where tasks are most likely overlapped. Also, because the majority of these approaches are designed based on bookmarks or at least implementing the bookmark concept, some pages may become obsolete.

Other studies, on the other hand, focused on studying factors influencing the use of web browsing and navigation as well as classifying tasks in the web. For instance, web tasks can be categorized into multiple tasks (i.e. tasks can be performed in a single session) and multiple session tasks (i.e. tasks that span into multiple sessions).

Various approaches that support task management in web browsing have been presented in the literature [2]. However, several issues in such approaches are still controversial, including the way of presenting and grouping tasks as well as properties and functionalities that should be provided in these approaches. Furthermore, literature at present lacks of design guidelines for designing and developing such approaches. In an effort to investigate the effect of incorporating

task management in the web, this paper presents a comparative study between TaskBar, a tool that works with Internet Explorer to help manage pending tasks in the web and the status quo web browser. The paper also presents a set of empirically derived guidelines for designing task management approaches for web browsers.

The rest of the paper is organized as follows: related work on task management in the web is reviewed first. Then the design and implementation of TaskBar is described. The methodology adopted to investigate the effect of incorporating task management particularly TaskBar in web browsing is reported next. Then the analysis of data obtained from the study is presented and is followed by a discussion of the findings and implications of the study and suggestions for future work directions.

## **2. RELEVANT WORK**

With the vast growth of web pages in the World Wide Web and their ubiquitous use, returning to previously seen web pages has become one of the main activities in the web. For instance, Tauscher and Greenberg pointed out that 58% of the visited web pages have been visited before [3]. Cockburn and McKenzie carried out a similar study after three years and found out that the rate of web revisit was increased to 81% [4]. Therefore, a vast number of studies have been devoted to investigating how web browsers can incorporate revisiting features. Several studies [5-9] focused on augmenting browsers' navigation components such as back buttons, bookmarks, and history to support web revisit better. Also, various web revisit approaches employing graphical representation and visualization techniques were proposed in the literature [10-14].

Task management has also become one of the highly required features in the web. Users usually use various techniques to keep information for later use while browsing, such as email, saving pages, bookmarks, printing, and writing notes [1, 15, 16]. However, with such methods, valuable information may get lost or become obsolete.

A limited number of studies have been carried out to investigate suitable solutions for such issues. Jones et al. [1], for instance, developed a simple prototype called "Add Favorite 2," which provides the same functionalities of bookmarks with the ability to add descriptions about the web page in addition to the option of sending the web page by email.

Furthermore MACKAY, KELLAR and WATTERS in [17] developed an add-in tool that works together with a web browser, called Landmark, to help users re-find information in a web page. In this tool, users can mark information on a web page and return back to this information later. An experiment was carried out to investigate the effectiveness of Landmark in re-finding information. The results demonstrated a reduced time for re-finding information using Landmark when compared to typical methods. However, these approaches simply provide reminding features only and do not provide any functionality for dealing with multiple tasks.

Various studies were carried out to investigate how task management can be incorporated into web browsing. For instance, Melanie, Carolyn and Michael conducted a study to understand the factors influencing the usage of web browsing and navigation [18, 19]. It was found that web usage can be categorized into several tasks: fact finding, information gathering, browsing and transactions. It was also found that various factors influence the use of the web, such as task type, session, and individual differences.

Recently, novel and more advanced approaches for supporting web browsers with task management were proposed in the literature. For instance, Natalie and Kari-Jouko developed an approach for supporting task management in the web browser [20]. They introduced a workspace that can be opened alongside the browser presenting a collection of URLs of interest based on short-term usage. Pages marked as tasks are presented in thumbnails in the workspace. One of the limitations of this approach is that users were required to drag and drop URLs manually into

the workspace. Also, task management functionalities other than drag-and-drop were not implemented. However, the results demonstrated an overall users' satisfaction.

Hupp and Miller, on the other hand, proposed a different type of web task management approach called Smart Bookmark [21]. It only records users' transactions in the web, for example flight booking, and enables replaying the actions of each transaction later. Bookmarked actions can be displayed here graphically, textually, and by using screen shots. The accuracy of extracting and recording actions in website was evaluated using twenty-five well-known websites. The results demonstrated a low correct extraction rate of actions (i.e. more than half of the websites). Furthermore, it only focused on one type of browsing activities, while others were neglected.

Morris, Meredith and Venolia also conducted a field study to investigate users' search habits in the web and found that search queries most likely span into multiple sessions and for long times [22]. Therefore, they proposed a system called SearchBar, which supports the management of search queries in an interrelated manner. Users could create a new topic and insert all relevant search queries in this topic. Each page could be marked to show special relevance. Also, a summary of each topic could be presented by clicking on the topic title. This summary shows several types of information such as user notes and special related pages. SearchBar was evaluated in terms of usability and the results demonstrated that it was easy to use and users used it extensively. However, it only supports search queries and neglects other browsing activities.

Web tasks can broadly be categorized in the literature into multiple tasks (MT), which are the tasks performed during a session, and multiple session tasks (MST), which are tasks that span multiple sessions. MacKay and Watters carried out a diary study and field study to understand how users perform MSTs [23]. They found users mostly performed similar actions in such tasks, such as opening new windows, searching, opening bookmarks, and using history. The results of these studies also help in the classification of tasks. More specifically, web tasks were classified into eight tasks which are school work, general topic search, research, travel, projects, actions, shopping, and status checking. Three main factors that should be taken into account when incorporating task management in browser were highlighted here. These factors were reminding features, tabbed browsing features, and managing tasks during sessions.

One year later, they developed three prototypes based on these guidelines [23]. These prototypes were similar in terms of easy access to multi-session tasks and in the way they were presented in the browser. The main difference among them is the functionality. For instance, the first prototype was the simplest, which provided creation of new tasks as well as stopping and resuming saved tasks. Beside these functionalities, the second prototype enabled the addition of web pages in active tasks. On the other hand, the third prototype consisted of additional four features. These features were specifying completion date for tasks, saving pages for later use, displaying pages according to the time viewed, and the ability to deal with them after the completion of tasks. An experiment was conducted to evaluate the usability of each prototype and the results demonstrated that the first and second prototypes did not significantly enhance users' browsing behavior, whereas the third prototype significantly reduced the usage of browsing-supporting tools such as bookmarks and history [23].

Wang and Chang [2] developed an approach called Multitasking Bar (MB) that worked together with Firefox to support browsing with multitasking management features. Tasks presented in MB as tabs with their name and status in the title of each tab. Pages related to each task also presented in tabs which could be only presented when the task was selected. Four attributes could be set when creating new tasks: name, status, end date, and active time. The results of the field study demonstrated that MB helped users complete tasks more effectively than traditional browsers. However, presenting tasks and their related web pages using tabs can be confusing and difficult to track, especially when the number of pages and tasks is high.

Recently, many efforts have been made to develop tools that better support task management in web browsing [17, 21, 23, 24]. However, the literature at present lacks guidelines for developing such tools and employing task management features in web browsers. To fill this gap in the literature, this paper presents an experimental work to define a set of guidelines for better employment of task management in web browsing.

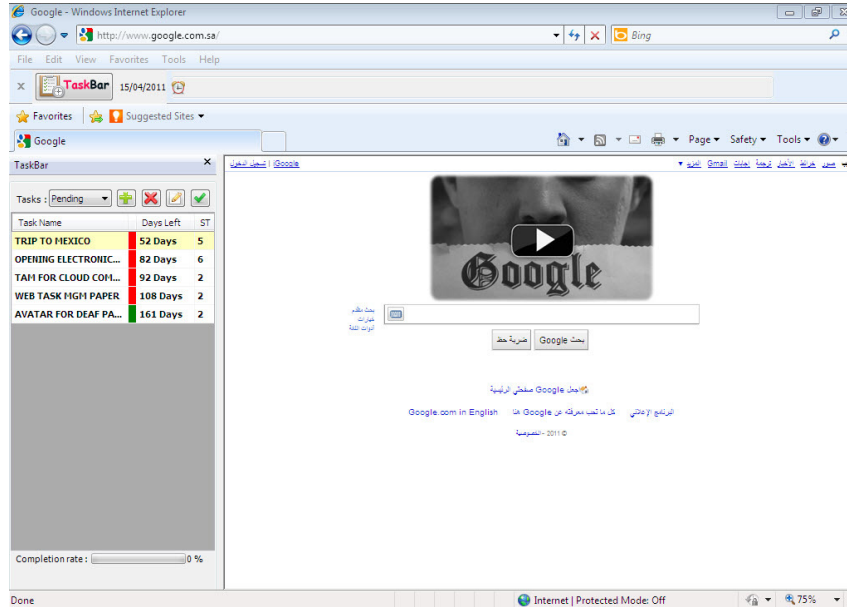


FIGURE 1: TaskBar Running the Browser with Pending Tasks Presented.

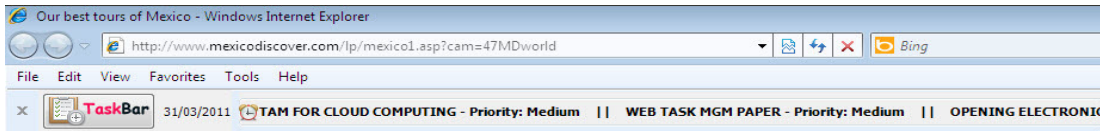


FIGURE 2: Pending Tasks Reminder Bar.

### 3. TASKBAR

To achieve the aims of this study, an experimental task manager was developed, called TaskBar, which works together with MS Internet Explorer. TaskBar enables users to manage ongoing (pending) tasks while browsing the web. The guidelines derived by MacKay and Watters for incorporating multi-session tasks in the browser were considered when developing TaskBar [24]. Furthermore, tasks here have the same four attributes (i.e. name, status, end date, and active time) of the Multitasking Bar developed by Wang and Chang [2] in addition to priority and notes. Unlike Multitasking Bar, tasks are presented in TaskBar in a list to reduce errors and confusion that could occur from a tabbed tasks view. It can also provide users with important features of task management such as reminding and priorities.

Previous tools allowed only the grouping of pages within multiple sessions but no valid classification between pages was presented. Archiving of completed tasks was also supported. The tool plays a to-do list in the browser and helps users decide which tasks should be dealt with first and which of them should be postponed.

One of the most important features of TaskBar is providing users with full structure of task management. Similar tools in the literature only allowed users to group related web pages in one tab as a task. However, such a method can overload users with tasks and hence cause difficulties in accomplishing and recalling tasks. On the other hand, tasks in TaskBar were

categorized into main tasks, subtasks and web pages. It runs automatically with IE (as an IE Add-on) in two sidebars connected to the main window and the tool bar (see Figure 1). The latter is used for pending tasks reminding (see Figure 2). Main tasks were categorized into three types based on their completion date: pending, overdue, and completed tasks.

Task Name	Days Left	ST
travel to uk	6 Days	1
TRIP TO MEXICO	67 Days	5
OPENING ELECTRONIC...	97 Days	6
TAM FOR CLOUD COM...	107 Days	2
WEB TASK MGH PAPER	123 Days	2
AVATAR FOR DEAF PA...	176 Days	2
Paris	Overdue	1
Liverpool	Overdue	3
London	Overdue	1
opening ceremony	Completed	2
FAMILY OUTING	Completed	3

Completion rate:  50 %

**FIGURE 3:** TaskBar with All Tasks Presented.

Task Name :

End Date :

Reminder :

Priority :

Note :

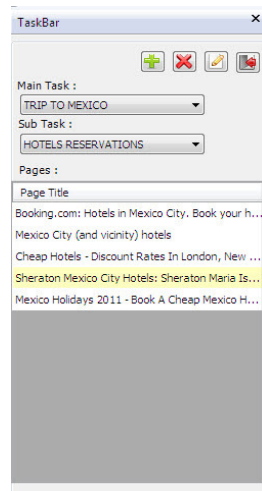
**FIGURE 4:** New Task Creation Form.

TaskBar automatically presents pending tasks in the sidebar when it is started and shows tasks reminder in the toolbar. The priority of tasks is encoded into colors (red for high, green for medium, and blue for low priority), number of days before the tasks are due, and number of subtasks presented with each task. These types of tasks were selected to be presented only in the side bar to reduce the complexity of presentation, especially with the small area used for TaskBar and because of the frequent use of these types of tasks. Other types of tasks (i.e. overdue and completed tasks) can be displayed by selecting them from the dropdown menu (see Figure 3). A new task can be added in TaskBar by clicking on new task button where a new window will be presented that enables users to enter the task name, end date, priority, and notes (see Figure 4). A reminder can also be set to a task by checking the reminder field and setting the date on which the reminder should be started. Such tasks start moving in the tool bar (Figure 2) with their priority starting from the reminder date until it was disabled or the task was marked as completed. Tasks shown in the reminder bar are ordered based on priority and due date.

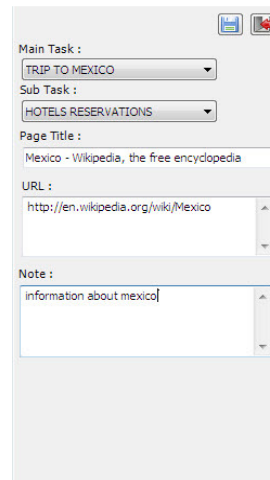
Moreover, a completion rate of each task is presented below the task list when it is selected. This completion rate is the percentage of subtasks completed under a main task. A task can be marked as completed by clicking on the "mark this task as complete" button when it is selected. It also can be edited using a similar window to (i.e. Figure 4) creating new task.

Subtasks under each task can be presented by double-clicking on the name of the main task. They are displayed in a separate window in a similar way to main tasks. However, the task name and number of days in which the task should be due only are presented here. The completion rate of subtasks is not presented because of the difficulties of calculating it with these types of tasks. In a similar way to main tasks, subtasks can also be deleted, edited, and marked as completed by clicking on the appropriate button after selecting the required subtask. The only difference in editing subtasks is the possibility of moving a subtask from a main task to another. This can be done by selecting a main task from the dropdown list in the editing form and then clicking on the save button. This feature gives users the flexibility of moving tasks to the appropriate category, especially with the large amount of information in the web that makes classification of information difficult.

Web pages can be added to subtasks in TaskBar by opening the page tab, double-clicking on the required subtask, and then selecting “add this page.” The title and URL of the selected web page are written automatically in the appropriate fields (see Figure 6). A short note can be added to the web page and the title of the web page can be changed according to users’ objectives. Many web pages can be added under a subtask where users can delete and edit them in a similar way to tasks. Web pages can be opened any time by double-clicking on their titles in the list (see Figure 5).



**FIGURE 5:**TaskBar with Pages Presented.



**FIGURE 6:** Form of Adding Pages to Tasks.

#### 4. METHODOLOGY

The methodology used by Morris et al. in [22] was adopted here with some modifications to suit our aims. An experiment was carried out which consisted of two sessions scheduled one week apart; each session lasted half an hour. Two groups of thirty subjects each were involved in this experimental study. The controlled group used Internet Explorer without any tools for supporting task management (from now on it will be referred to as IE) to perform experimental tasks. The experimental group also used Internet Explorer but with the TaskBar. The experimental group was given a fifteen-minute demonstration about TaskBar prior to the start of the first session.

At the beginning of the first session, subjects were told that they would be asked to perform two main tasks and might be asked to accomplish some tasks instantly while performing the main tasks. These tasks were performed several times in a pilot study prior the experiment to estimate the time needed to complete each task. The minimum time required to complete all tasks was fifty minutes, meaning subjects most likely would not finish all tasks in one session.

Main tasks were also adopted from [22] and modified to suit the study aims. For instance, subjects were asked in the first task to book a flight to Sao Paulo, Brazil on given depart and return dates and find the best two offers in terms of cost and flight duration. They were also asked to write the airline name, route, number of stops, price, and duration in the answer sheet provided to them. Furthermore, subjects were asked in the second task to prepare a report about cloud computing. Parts of the report were already prepared and they were asked to complete the missing parts.

After ten minutes from the start of the session, subjects were asked to stop working in the main tasks and carry out two tasks instantly in a seven-minute interval. First, they were asked to find three pizza restaurants in Chicago. Restaurant name, phone number, and address were required to be written in the answer sheet. Second, they were asked to find two offers for digital cameras

with prices less than \$75. Camera brand name, price, resolution, color, and main features were required in the answer sheet.

At the end of this session, subjects were asked to fill a questionnaire soliciting demographic information, information about browsing habits, and information about experimental tasks. Files, including bookmarks, history, and TaskBar files in all computers were saved to be used in the second session. However, answer sheets were collected from subjects before leaving.

In the second session, the setup was the same as in the first session and all files remained as they were left by subjects. At the beginning of this session, subjects were asked to report on their progress of tasks in the first session by writing the task name (i.e. description), deadline, and status (i.e. completed or not). Ten minutes later, they were asked to stop working on the report and all reports were collected.

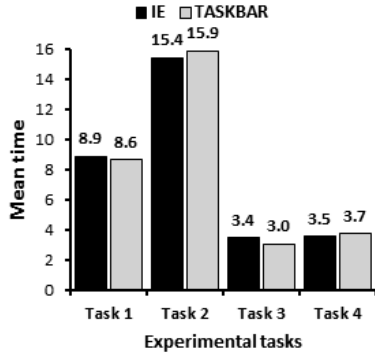
The subjects were then reminded about the tasks requested in the first session and were asked to perform four new tasks. These tasks were required to be performed in the same order at five-minute intervals. In each task, subjects were asked to find information related to the tasks in the first session. For instance, subjects were asked in the first task to find the price and airline name of the cheapest offer for the Sao Paulo trip. In the second task, they were also asked to find three applications of cloud computing. The name and phone number of one of the pizza restaurant found in the first session were required in the third task. Finally, the brand name and price of the cheapest digital camera found in the first session were required in the fourth task. At the end of the session, subjects were asked to complete a questionnaire soliciting information about experimental tasks and overall satisfaction.

Measure	Items	Frequency	Percent
Gender	Male	60	100%
Education	Bachelor	44	73.3%
	Master	14	23.3%
	PhD	2	3.3%
Browser Used	IE	60	100%
Daily usage of the internet	1-3	8	13.3%
	4-6	25	41.7%
	7-9	21	35%
	more	6	10%
Ways of dealing with pending tasks	Bookmarks	38	63.3%
	Print pages	15	25%
	Other	7	11.7%

**TABLE 1:** Descriptive Statistics of Sample.

## 5. SAMPLE

Sixty employees working in Taibah University at Medina in the Kingdom of Saudi Arabia were voluntarily recruited to participate in this experimental study. All of them were males aged between 24 and 32 years old with an average age of 28 years. Table 1 shows descriptive statistics of the sample characteristics. It shows that all users used Internet Explorer as the main browser used for surfing the internet. Moreover, the majority (i.e. 41.7%) of the sample spent approximately four to six hours a day using the Internet. Also, the majority of the users used bookmarks as the main way of dealing with tasks in the web whereas none of them indicated that they emailed themselves as a reminder of pending tasks.



**FIGURE 7:** Mean Time Taken to Complete Tasks in Session 1.

Tasks	Results
Task 1	( $t_{58}=0.79, p= 0.43$ )
Task 2	( $t_{58}= - 1.29, p=0.2$ )
Task 3	( $t_{58}= 1.52, p=0.13$ )
Task 4	( $t_{58}= - 0.57, p=0.57$ )

**TABLE 2:** T-test Results of Time Taken to Complete Tasks in Session 1 at '0.05' Significance Level.

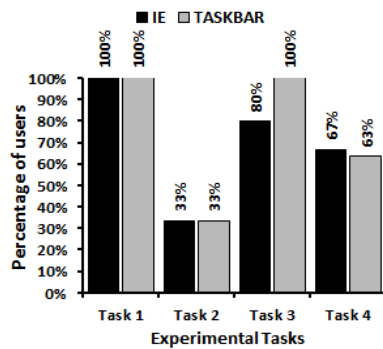
## 6. RESULTS

To compare between TaskBar and the control condition used for managing tasks in the web, the time taken to complete tasks and rate of task completion were calculated in the two sessions. Users' satisfaction was also taken into account when comparing the experimental conditions. The obtained data from the two sessions was analyzed independently.

Figure 7 shows the mean time taken to accomplish each task using TaskBar and IE in the first session. The total time taken was not calculated and used for comparison because the session length was set to be the same and therefore the total time of completion would almost be the same in the two conditions. Furthermore, the experimental tasks were designed to have different complexity levels, which helps explain the distribution of session time among tasks.

Figure 7 demonstrates that the time taken to the complete first session's tasks fluctuated between TaskBar and IE. For instance, the mean time taken to accomplish the first and third tasks was slightly higher in IE than in TaskBar. On the other hand, users required longer time to complete second and fourth tasks in TaskBar than using IE.

A T-test was applied here to investigate the significance of this difference. The results are shown in Table 2. The time taken to accomplish the experimental tasks was not significantly reduced in the two conditions in the first session.



**FIGURE 8:** Rate of Tasks Completion in Session 1.

Tasks	Results
Task 3	( $X^2=6.7, df=1, p=0.01$ )
Task 4	( $X^2=0.73, df=1, p=0.78$ )

**TABLE 3:** Chi-square Results of Completion Rate in Session 1 at '0.05' Significance Level.

Figure 8 shows the percentage of users who successfully completed each task using IE and TaskBar in the first sessions. The number of users who completed each task also fluctuated between IE and TaskBar. For instance, the same number of users completed the first and second tasks (30 and 10 users) in IE and TaskBar. However, only 80% of users completed the third task in IE whereas 100% completed it in TaskBar. On the contrary, the percentage of users who completed the fourth task was slightly higher (67%) in IE than in TaskBar (63%).



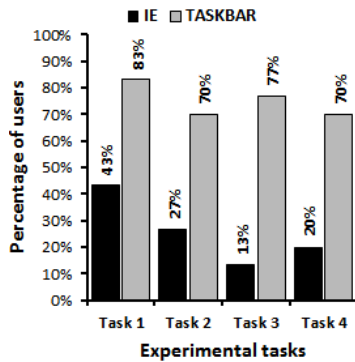
A Chi-square test was applied to the number of users who completed each experimental task to investigate the difference between the two conditions. The results are shown in Table 3. The number of users who completed task 3 in TaskBar was significantly higher than IE, while no significant difference in other tasks was shown.

**TABLE 4:** Mean Users' Response On Questionnaire Statements In Session 1.

Statements	Condition	
	IE	Taskbar
How easy was it to perform the required tasks?	2.67	3.90
It was easy to create a new task.	2.23	3.87
It was easy to set a deadline for tasks.	1.90	4.00
It was easy to name tasks.	2.53	4.17
It was easy to deal (sort, move, and delete) with tasks.	1.67	3.57
It was easy to priorities for tasks.	1.73	4.03
It was easy to set the task reminder.	1.83	4.03
It was easy to deal with multiple tasks.	2.27	3.83
It was easy to understand the progress of tasks.	1.83	3.93
In overall, what is your overall satisfaction with performing experimental tasks?	2.27	3.93
Overall mean of users' responses:	2.09	3.93

The obtained data from questionnaires distributed at the end of the session was also analyzed independently. Table 4 shows the mean users' responses to each statement for both experimental conditions. The mean was calculated because these questions were set to measure users' satisfaction and according to other research [25], Likert scale questionnaires can be analyzed quantitatively when they are combined in a single composite.

The mean users' response to TaskBar was higher in all statements than IE, although their performance during the session was almost the same. For instance, Table 4 shows the mean users' responses ranged from 3.57 to 4.17, whereas performance ranged from 1.67 to 2.67. A T-test was applied to the overall mean of users' responses to all statements to investigate the significance of the difference between IE and TaskBar. The results indicated that users were significantly more satisfied with TaskBar than IE ( $t_{58}=11.35, p<0.01$ ).



**FIGURE 9:** Rate of Users' Progress of Tasks Performed In Session 1.

Tasks	Results
Task 1	( $X^2=10.34, df=1, p<0.01$ )
Task 2	( $X^2=11.28, df=1, p<0.01$ )
Task 3	( $X^2=24.31, df=1, p<0.01$ )
Task 2	( $X^2=15.15, df=1, p<0.01$ )

**TABLE 5 :** Chi-square Results of Users' Progress of Tasks In Session 1 at 0.01 Significance Level.

As mentioned previously, users were required at the beginning of the second session to report on their progress in session 1. To measure the progress rate of tasks, users who answered all questions related to each task were considered to have reported on the task successfully. Figure 9 shows the percentage of users who successfully reported on each task. It shows the percentage of users who used TaskBar reported their tasks dramatically higher than those who used IE. For instance, only 43% of the users who used IE in the first session could report

successfully on the first task whereas 83% of those who used TaskBar reported on it successfully. Furthermore, TaskBar helped 70%, 77%, and 70% of users successfully reporting tasks 2, 3, and 4 respectively. However, only 27%, 13%, and 20% of users who used IE completely reported on the same tasks. A Chi-square test was applied here to investigate the significance of this difference. The results are shown in Table 5. The number of users who reported successfully on each task using TaskBar was significantly higher than IE.

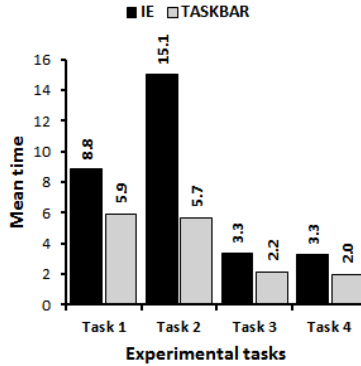


FIGURE 10: Mean Time Taken to Complete Tasks In Session 2.

Tasks	Results
Task 1	( $t_{58}=13.19, p<0.01$ )
Task 2	( $t_{58}=35.64, p<0.01$ )
Task 3	( $t_{58}=4.41, p<0.01$ )
Task 4	( $t_{58}= -5.37, p<0.01$ )

TABLE 6: T-test Results of Time Taken to Complete in Session 2 Tasks at 0.01 Significance Level.

The mean time taken to complete each task and the completion rate was also calculated in session 2. Figure 10 shows the mean time taken to accomplish each task using IE and TaskBar in session 2. Unlike session 1, it shows that time taken to accomplish all tasks in TaskBar was dramatically reduced when compared to IE. For instance, users required 8.8 minutes to complete the first task in IE, but only 5.9 minutes on average were required to complete it in TaskBar. Furthermore, users who used TaskBar successfully completed task 2 with only 38% (i.e. 5.7 minutes) of the time taken (i.e. 15.1 minutes) by those who used IE. Figure 10 also shows that users required 3.3 minutes to complete tasks 3 and 4 in IE whereas only 2.2 and 2 minutes were required to complete the two tasks in TaskBar, respectively. A T-test was applied to the time taken to complete each task to investigate the significance of this difference. The results are presented in Table 6. TaskBar helped users complete all tasks in session 2 with significantly reduced times when compared to IE.

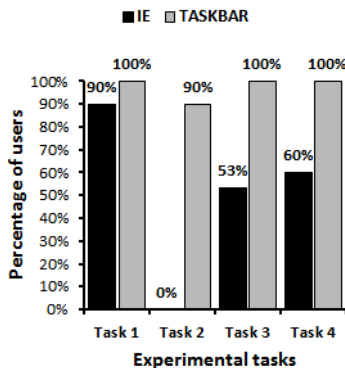


FIGURE 11: Rate of Tasks Completion in Session 2.

Tasks	Results
Task 1	( $X^2=3.16, df=1, p>0.05$ )
Task 2	( $X^2=60.00, df=1, p<0.01$ )
Task 3	( $X^2=18.26, df=1, p<0.01$ )
Task 4	( $X^2=15.00, df=1, p<0.01$ )

TABLE 7: Chi-square Results of Completion Rate in Session 2 at 0.01 Significance Level.

Figure 11 shows the percentage of users who completed each task in session 2 using TaskBar and IE. It shows the percentage of users who completed tasks using TaskBar was also noticeably higher than IE. For example, none of the users completed task 2 using IE while 90% of the users completed it using TaskBar. Moreover, all users completed tasks 3 and 4 in TaskBar whereas only 53% and 60% completed these tasks in IE, respectively. A Chi-square test was applied to these results to investigate the significance of the difference. The results demonstrated that the

number of users who completed task 1 in TaskBar was not significantly higher than those who completed it using IE (see Table 7). Table 7, on the other hand, shows that the number of users who completed tasks 2, 3, and 4 in TaskBar was significantly higher than IE.

Statements	Condition	
	IE	Taskbar
How easy was it to perform the required tasks?	1.67	3.67
It was easy to create a new task.	1.93	4.13
It was easy to set a deadline for tasks.	1.47	3.93
It was easy to name tasks.	2.00	4.03
It was easy to deal (sort, move, and delete) with tasks.	1.70	3.47
It was easy to prioritize tasks.	1.33	4.03
It was easy to set the task reminder.	1.37	4.17
It was easy to deal with multiple tasks.	1.80	3.60
It was easy to identify task progress.	1.20	4.23
It was easy to remember pending tasks.	1.20	3.87
It was easy to identify important tasks.	1.17	4.03
It was easy to identify task deadlines.	1.23	4.03
It was easy to resume and carry on pending tasks.	1.37	3.90
What is your overall satisfaction in performing the experimental tasks?	1.67	3.80
Overall mean of users' response	1.5	3.9

**TABLE 8:** Mean Users' Responses to Questionnaire Statements in Session 2.

Users' responses regarding IE and TaskBar in this session were analyzed in a similar way to session 1. Table 8 shows the mean users' responses to each statement of the two conditions. It also shows that users' responses to TaskBar were higher than IE in all statements. The mean users' responses about TaskBar ranged from 3.47 to 4.23, while there responses about IE ranged from 1.17 to 2. A T-test was applied to the overall mean users' responses to investigate the significance of this difference. The results indicated that TaskBar was significantly more satisfying for users than IE ( $t_{58}=18.39$ ,  $p < 0.01$ ).

## 7. DISCUSSION

The results of the first experimental session demonstrated that TaskBar did not help users complete tasks with reduced time or with higher completion rates when compared with IE (i.e. controlled condition). On the contrary, users of IE sometimes outperform those using TaskBar in terms of time and completion rate. These results were expected because TaskBar was designed to facilitate dealing with pending tasks, which required users to perform extra work in the first session, such as entering tasks' names, setting priorities, and deadlines. On the other hand, users performing tasks using IE in the first session worked on tasks immediately without using a particular way of saving tasks for future use. Though, the results obtained from the questionnaire at the end of the session demonstrated that TaskBar was more satisfactory than IE.

The potential of TaskBar clearly appeared in the second session. Some users also used bookmarks to save web pages so they could return to them the next session, where others used notepad or other word-processing software to save page content or links. For instance, the majority of users who performed experimental tasks without using a task manager in the first session could not report on their progress at the beginning of the second session. This is because of the difficulties faced in finding required pages in bookmarks and related files. TaskBar, on the other hand, helped increased (nearly double) the percentage of users who reported successfully on their progress of the first session.

The majority of users who used the control condition repeated the tasks required in the first session to complete the tasks of the second session. Consequently, the results showed that the time taken to complete tasks using TaskBar was dramatically reduced when compared to the control condition. Storing task information in the TaskBar helped most of the users complete all the tasks. More specifically, almost all users (except 3 who could not complete task 2) finished all

tasks within the time specified for the session. The results obtained from questionnaires at of this session confirmed that using a task manager in the web, particularly TaskBar, was more satisfactory than dealing with tasks without using any assistant tools. For instance, the majority of users found that setting task deadlines, priorities, and dealing with multiple tasks was easier in TaskBar but not in the controlled condition.

## 8. GUIDELINES

These results can be interpreted into various design guidelines for incorporating task management features in web browsing. First, task management approaches in web browsers should be developed independently with browsers' navigation functionalities, particularly bookmarks. Various studies in the literature demonstrated bookmarks are not used by the majority of web users and bookmarked pages usually become obsolete.

Second, pages should not be marked or dragged to a particular area of the screen without being classified into tasks. Otherwise, various tasks will overlap or be scattered in different places. Tracking task progress will become difficult and valuable information may get lost.

Third, the way to present tasks plays an important role in facilitating dealing with multiple tasks. A tabbed view is one of the ways used for presenting tasks and their web pages. Many limitations were observed using tabbing for presenting tasks in web browsers. Users most likely become overwhelmed with the web pages presented, especially with large tasks. Also, the whole area used for presenting tasks in such a way may be occupied with a limited number of tasks and important task information may not be displayed due to the limited space of tabs. For example, a task containing a large number of subtasks can easily occupy the whole area for presenting tasks. The list view used in TaskBar (see Figure 1 and Figure 3) helped present multiple tasks with important information such as due date and priority without overloading users with pages included in each task because they could be displayed by expanding the required task.

Fourth, presenting all tasks can also overload users with unimportant information and take the place of more important information, especially with the limited presentation area. Tasks with high priority and approaching their due dates should have the priority of presentation in the main view, while unimportant, completed, low priority, and distant due date tasks may be presented in a separate view and displayed when needed.

Fifth, tasks must have various properties to facilitate dealing with multiple tasks. For example, task name, due date, priorities, and notes are some of the important attributes of web tasks that can be considered when designing web task manager approaches.

Sixth, as suggested by Mackay and Watter [24], a reminder is one of the main features that must be taken into account when designing a web task manager. However, important tasks may also be forgotten with a normal task reminder, especially when a large number of tasks exists. To avoid missing important tasks, users must be aware of such tasks continually. Therefore, a nonstop reminder such as the one implemented in TaskBar (see Figure 2) should be taken into account when developing a task manager for web browsers.

## 9. CONCLUSION

This paper presented the design and evaluation of an approach called TaskBar, developed to improve web browsing by incorporating task management features in web browsers. TaskBar works together with Microsoft Internet Explorer and enabled dealing with selected web pages as tasks by providing several functionalities of task management such as reminders, and setting deadlines and priorities. It differs from currently available approaches mainly in two aspects: the way it presents tasks and the impartiality from web browser navigation features (i.e. bookmarks and history). A two-session controlled experiment was carried out to investigate the effect of employing task management features in web browsers. In this experiment, users' performance in TaskBar and a status quo web browser (Internet Explorer) were compared in terms of task

completion time, completion rate, and users' satisfaction. The results showed that incorporating task management features in web browsing, particularly TaskBar, helped users return to and accomplish pending tasks in the web with significantly improved accomplishment time and higher completion rate when compared with a typical web browser. The results also demonstrated a dramatically high rate of users' satisfaction with TaskBar. Finally, the paper presented a set of design guidelines for incorporating task management in web browsing which was derived based on these results.

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