

# Providing an Accessible Track Changes Feature for Persons Who Are Blind

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**Abstract.** Collaborative writing applications are widely utilized in the work place to co-author documents and to exchange ideas. Unfortunately, persons who are blind have difficulty in identifying the changes and their related context, which prevents them from actively participating in collaborative writing. In order to expand on the knowledge gained from previous research, additional usability studies were carried out with participants who are blind utilizing Microsoft Word with the focus on track change and comment features. Based on results from all the previous usability studies, a Microsoft Word Add-In was proposed to solve the issues identified. This paper briefly presents the results of the usability studies, the prototype design of the Microsoft Word Add-In and a pilot review of the Microsoft Word Add-In for making the track change and comment features accessible and usable.

**Keywords:** Collaborative writing, accessibility, usability, blind.

## 1 Introduction

According to World Health Organization [13], about 285 million people are visually impaired worldwide, among them 39 million are blind. Collaborative writing in organizations has become essential for exchanging and sharing ideas. Unfortunately, persons who are blind have experienced accessibility and usability issues while interacting with popular collaborative writing applications, such as Microsoft Word and Google Docs [9].

As an early attempt on designing a more accessible collaborative writing application, several usability study sessions were conducted [9] to establish a baseline for the current collaborative writing features provided. However, most of the participants of these study sessions were experienced users of the collaborative writing tools.

In order to verify whether the baseline data collected from the previous usability study [9] is consistent with a more diverse user population and to identify the solution to the issues identified additional usability study sessions were conducted with persons who are blind with no residual vision to address the following questions.

The following research questions were addressed:

- RQ1: What accessibility and usability issues do collaborative writing technologies, such as Microsoft Word, present for persons who are blind? And,
- RQ2: How should a collaborative writing interface be designed in order to be accessible and usable for persons who are blind?

This article builds upon the earlier work [9] and results from additional usability study sessions, exploring the design of a proposed Microsoft Word Add-in that can potentially solve the issues identified when answering the two research questions. After briefly presenting the usability studies that investigates the above research questions, this article presents the design of the proposed solution. The potential benefits of the proposed design, the pilot review of the Microsoft Word Add-In and the future research directions are discussed.

## **2 Related Work**

Several usability studies were reported [9] which identified the issues that persons who are blind experience when using collaborative writing tools. Using Microsoft Word with the JAWS screen reader, participants from those studies were requested to complete a set of collaborative writing tasks including starting a collaborative writing session by opening a document and setting the "track change" feature, identifying the comments/changes in a given document, searching for a specific change/comment in the document, adding a change/comment to the document, accepting/rejecting a change in the document. All of the participants who are blind were expert users of both Microsoft Word and the JAWS screen reader. These studies showed that the majority of blind participants did not think Microsoft Word is flexible and understandable. They experienced problems when trying to identify specific changes/comments, and were not able to identify the context of the revisions and comments presented in the document. In addition, there was no direct access for blind users to operate on the existing changes in the document.

## **3 Additional Usability Study**

Due to the lack of variance in the participants' previous experience levels in the prior usability studies, it is necessary to check whether the results can be applied to other users who have less experience with Microsoft Word and the JAWS Screen Reader. Therefore, additional usability study sessions were conducted to include participants with less experience using the same research instruments.

### **3.1 Participants**

Participants were recruited from local universities and businesses, giving a total of eight participants for all usability studies. The genders of participants were evenly distributed, with four (50%) females and four (50%) males. The ages of the subjects

were distributed from 19 to 59 years. The majority of the participants (62.5%) were between 19 and 39 years of age.

Half (50%) of the participants had twenty-one to thirty years of experience utilizing the computer and the JAWS Screen Reader. All of the participants utilized the computer daily (100%), and primarily used to computer at work (62.5%) or at school/college (37.5%). Half (50%) of the participants had eleven to twenty years of Microsoft Word experience.

### 3.2 Task Performance

All (100%) participants were able to successfully complete the tasks that requested them to open the document and start a "track change" session, add a change, delete and change text, and add a comment to the document. 37.5% of the participants did not complete the tasks related to searching for changes and accepting/rejecting changes.

The participants took the longest time when adding a change (252 seconds), adding a comment (202.5 seconds) and accepting/rejecting the remaining changes (249 seconds). There were big variations in terms of the time spent on completing the tasks. This was reflected in the big standard deviation observed. For example, the participants spent 155 seconds on average to search for changes, with a standard deviation of 67.82. Participants were able to finish the tasks in a shorter time when they deleted text (78.12), change text (70.62), accept a change (73) and reject a change (89).

Table 1 presents the categories identified based on the transcripts from the usability study audio/video recordings collected during the usability studies.

### 3.3 Results

Comparing to the original usability studies [9], the additional usability studies highlighted similar key areas where persons who are blind had difficulty in completing tasks related to searching for changes and accepting/rejecting changes.

The difficulty of searching the ribbon menu structure in order to search for changes was expressed as a reason for not being able to complete the searching changes and accepting/rejecting changes tasks. A participant commented that they are, *“Not familiar with the ribbon menus and finding the track changes menu items takes time, which can take some getting used to.”*

In regard to the interactions with Microsoft Word’s interface, 37.5% of the participants thought that the interactions with Microsoft Word’s interface were not flexible, and 62.5% of the participants thought that Microsoft Word’s interface was not clear and not easy to understand. The participants considered track changes difficult to distinguish and understand unless they accepted all of the changes before reviewing the document. The comments were also difficult to distinguish and understand because the contexts of the comments were not clearly presented.

37.5% of the participants who are blind thought that the tasks were not easy to complete, and they were dissatisfied with the time they took to complete the tasks.

50% of the participants who are blind disagreed that they were able to complete the tasks without any problems.

Based on all the usability studies conducted, the participants who are blind suggested the following improvements to make the application more accessible: (1) clearly differentiate the text from the comments; (2) provide the context of inserted/deleted changes and comments by providing paragraph content with the changes and comments; (3) notify the user when text is added/deleted or accepted/rejected; and (4) give the ability to review changes in their accepted form.

**Table 1.** Categories identified from audio/video recordings

Category	Annotated List Element
1. Searching techniques utilized	<ul style="list-style-type: none"> <li>• Searching/reading word-by-word with the tab key</li> <li>• Scrolling up/down with the up/down-arrow keys</li> <li>• Tab key to parse menu items</li> <li>• Find / replace menu access key</li> <li>• JAWS hot keys (Insert/Shift/R) to search MS Word's Revisions' list</li> </ul>
2. Selecting techniques utilized	<ul style="list-style-type: none"> <li>• Selecting text with the alt-shift-right-arrow keys (word select)</li> <li>• Selecting letters with the shift-right-arrow keys</li> <li>• Selecting (tabbing) word-by-word</li> </ul>
3. Editing techniques utilized	<ul style="list-style-type: none"> <li>• Right-click (accept/reject list)</li> <li>• Copy (control-c)/Paste (control-v) keys</li> <li>• Typing text with a standard keyboard</li> </ul>
4. Reading techniques utilized	<ul style="list-style-type: none"> <li>• JAWS Screen reader to read text</li> <li>• Braille keyboard to read text (used in conjunction with standard keyboard)</li> </ul>
5. Accessibility and usability issues	<ul style="list-style-type: none"> <li>• Participants cannot determine the context of the comments</li> <li>• JAWS "Say All" feature doesn't always read the revisions/changes as revisions/changes (Cannot determine/identify the changes when read in the sentence)</li> <li>• Changes in the revisions list do not show context</li> <li>• Changes are entered in the incorrect position within the sentence/paragraph due to incorrect cursor position</li> <li>• Extra access time searching menus for features</li> <li>• Extra access time searching for text insertion point</li> </ul>

## 4 Proposed Solution

Based on the data analysis from the usability studies, it is clear that providing the context for the revisions is the key for persons who are blind to successfully utilize track changes and comments features of Microsoft Word.

Since Microsoft Word is still one of the most frequently used editing tools in the work place, the solution needs to be able to work with Microsoft Word seamlessly. With Microsoft Word's Application Add-In [12], it is possible to provide context

information more clearly. Therefore, we propose to develop a Microsoft Word Application Add-In [12].

#### **4.1 Microsoft Word Application Add-In**

A Microsoft Word Application Add-In is a tool or application that is developed to integrate with Microsoft Word in order to expand or enhance the features of Microsoft Word. In this case, A Microsoft Word Application Add-In will be designed to improve the access and use of track changes and comments features included with Microsoft Word. This Add-In would be set at the application level, allowing the developed features to be available for any Microsoft Word document. In order to access the revisions and comments, the Microsoft Word Paragraphs [4], Revisions [5] and Comments [6] Collections are accessed to present the revisions and comments within the context of their paragraphs.

#### **4.2 Features Proposed**

The proposed Microsoft Word add-in will be compatible with different versions of Microsoft Word and provides the following features:

1. Provide a comprehensive view of all revisions and comments.
2. Present the context (paragraph or sentence) of each comment and revision.
3. Identify each revision as an addition, a deletion, or a change.
4. Present each comment separately.
5. Select/highlight each revision/comment in series.
6. Providing direct access to the features of the Add-In through a Microsoft Word Command Bar.
7. Provide the “Final” view, as if the revisions are applied, for each paragraph or sentence.
8. Provide the “Revision” view, with the in-line revisions, for each paragraph or sentence.
9. Compatible with JAWS 13.
10. Provide optional audio feature as an alternative to JAWS.

The following sections discuss each feature in more detail.

##### **Comprehensive View**

To provide a comprehensive view of the revisions and comments, the Microsoft Word Add-In presents an overview of the total number of paragraphs or sentences, along with the total number of revisions and comments (Figure 1). This overview is necessary for any person to know immediately whether they have revisions or comments to review.

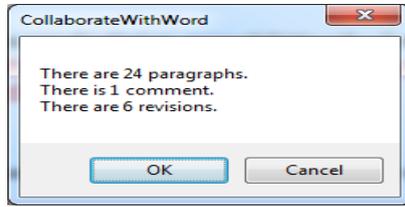


Fig. 1. Overview

### Paragraph or Sentence Context

Based on the comments of the participants of the baseline usability study [9], it was determined that the context of a revision or comment was necessary to the understanding of the revision or comment being reviewed. However, Microsoft Word does not properly present the context of revisions or comments, making review difficult for persons who are blind [9]. In order to provide the proper context for revisions and comments, the paragraph (Figure 2) or the sentence containing the revision or comment is presented.

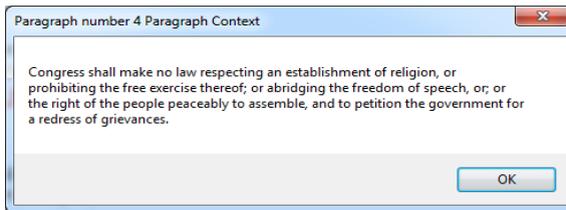


Fig. 2. Paragraph or Sentence Context

### Revision Type

In addition to the context of a revision or comment, it is essential that the type of revision be identified. The developed Microsoft Word Add-In provides for addition, change and deletion revisions (Figures 3).

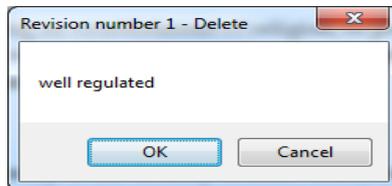


Fig. 3. Delete Revision

### Present Each Comment

The comments in the document will be presented one by one when the user requests it.

### Select Revision/Comment

In order to act upon any revision or comment, the revision or comment must be selected by the Microsoft Word Add-In (Figure 4). Once selected (highlight in blue), the revision can be accepted or rejected. The selected comment can be deleted.

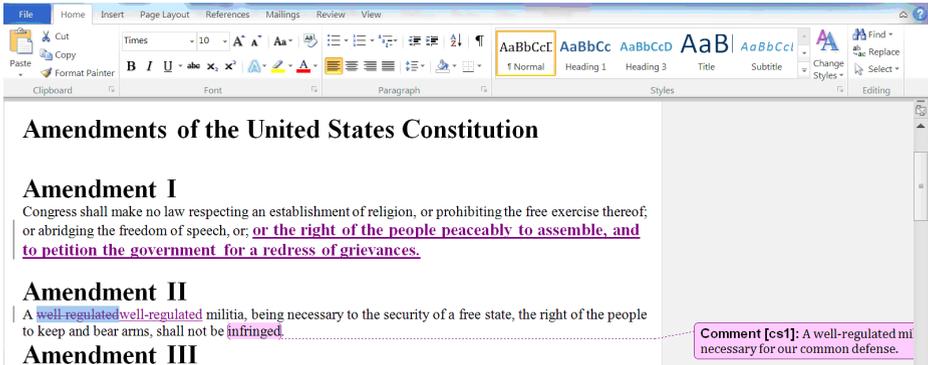


Fig. 4. Revision View with a selected revision (highlight in blue)

### Provide Direct Access

Since accessing the Microsoft Word Ribbon Menu was a usability issue for the participants who are blind [9], and in order to provide seamless interface integration of the Microsoft Word Application Add-In [12] with Microsoft Word, the Microsoft Word Command Bar (Figure 5) [7] was utilized to add features necessary to provide improved access and use of the track changes and comments features of Microsoft Word.

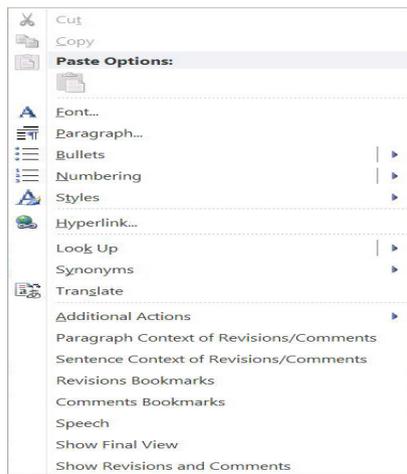


Fig. 5. Microsoft Word Command Bar

The Microsoft Word Command Bar would allow the end-user the ability to avoid accessing the Microsoft Word Ribbon Menu by simply right-clicking anywhere on the document to access the Command Bar, to directly access the application's features.

### Revision View versus Final View

The baseline usability study participants prefer to have alternative views of the paragraphs and sentences with revisions and comments [9]. Users should be able to toggle between two views depending on their own preference: to review the content with the revisions (Figure 4), or to review the content after the revisions are applied (Figure 6).

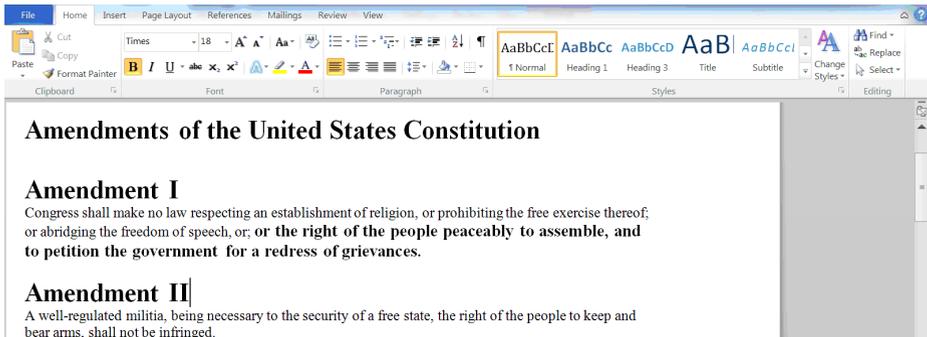


Fig. 6. Final View

### JAWS and Built-In Audio

The JAWS Screen Reader [2] is the standard output device utilized by persons who are blind in order to interface with any computer application. Therefore, the developed Microsoft Word Add-In and Microsoft Word Command Bar have to be compatible with the JAWS Screen Reader. The Microsoft Word Add-In and the Microsoft Word Command Bar and the message boxes presented by the Add-In have been validated to work seamlessly with the JAWS Screen Reader.

Alternatively, a Microsoft Speech API was included in the development of the Microsoft Word Add-In, to provide audio output for persons who did not have access to the JAWS Screen Reader. No content is displayed on the interface, only the audio content representing the messages boxes that would otherwise display for the JAWS Screen Reader.

### 4.3 Microsoft Word Add-In Benefits

The proposed Microsoft Word Add-In provides many benefits to the users. Since the Add-In is a component of Microsoft Word, it will be seamlessly integrated into Microsoft Word. Users do not need any prior knowledge to utilize the Command Bar, since they can simply right-click anywhere on a document to have direct access to the commands. With this direct access feature, there is no need to memorize complex key stroke combinations when working on the document. Therefore, the cognitive load will

be reduced to prevent overload. Since the Add-In will be applied at the application level, it will work with all Microsoft Word documents. It provides descriptive information regarding any comments/revisions including their sequence as well as type and content of the revisions. In addition, users will be presented with an overview of the document and context of the revision/comments so that users will be aware of the context of any action. The Add-In can be upgraded to different versions of Microsoft Word and is compatible with the JAWS screen reader. This eliminates the need for additional investment for the application to be accessible.

## 5 Pilot Usability Study

On January 17, 2013, a pilot usability study was conducted at the NFB with a participant who was blind with no residual vision, in order to examine and suggest improvements to the developed Microsoft Word Add-In. The participant had experience utilizing Microsoft Word (6 to 10 years) and the JAWS Screen Reader (11 to 20 years) on a daily basis. The participant's role at the organization was as a member of the public relations team which was responsible for correspondence with the public.

The participant "*agreed*" that the Microsoft Word Add-In interface was clear and understandable, and "*strongly agreed*" that the Microsoft Word Add-In interface was flexible and easy to use, improved performance, and enable tasks to be completed without any problems. Further, the participant "*strongly agreed*" that he was satisfied with the time he took to complete the study tasks, and that he would utilize the Microsoft Word Add-In interface in the future on a regular basis.

The participant reported that the Microsoft Word Add-In interface "*helps place the revision in context and identifies exactly what is being changed. It also provides easier access to the comments than just the screen reader.*"

The participant suggested "*some clarification of language on some menu options and message boxes*" as improvements to the Microsoft Word Add-In interface.

## 6 Conclusion

The prior usability studies [9] concluded that the participants who are blind were out-of-range when compared with the visually able participants in several collaborative writing tasks. Given the result from the prior usability studies, additional participants who are blind participated in usability studies to validate the baseline quantitative measures related to task completion times, the qualitative analysis on notes and audio recordings related to participants' preferences collected, and to expand on the experience and age demographics. What was discovered is that as the experience level drops, so does the ability to complete certain collaborative writing tasks related to revisions and comments. Based on these results, it was decided that an improvement to the Microsoft Word interface was necessary to improve access to revisions and comments and to provide the context of the revisions and comments.

The proposed solution, which includes a Microsoft Word Application Add-In [12], will enable all persons to review revisions and comments in any Microsoft Word

document by directly accessing the Microsoft Word Command Bar [7]. Simply right-clicking anywhere on the document will prompt the Command Bar to be activated and direct access is available to the revisions, the comments, and the context of the revisions and comments. This direct access will promote ease of use and the ability of all persons to be able to complete all collaborative writing tasks.

The pilot usability study provided positive responses in regard to the access and use of the Microsoft Word Add-In interface, which now will undergo extensive review with additional participants. The Microsoft Word Add-In will be available at some future time for general distribution.

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