

Coding Non-Visually in Visual Studio Code: Collaboration Towards Accessible Development Environment for Blind Programmers

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This paper delineates a fruitful collaboration between blind and sighted developers, aiming to augment the accessibility of Visual Studio Code (VSCode). Our shared journey is portrayed through examples drawn from our interaction with GitHub issues, pull requests, review processes, and insider’s releases, each contributing to an improved VSCode experience for blind developers. One key milestone of our co-design process is the establishment of an accessible terminal buffer, a significant enhancement for blind developers using VSCode. Other innovative outcomes include Git Diff audio cues, adaptable verbosity settings, intuitive help menus, and a targeted accessibility testing initiative. These tailored improvements not only uplift the accessibility standards of VSCode but also provide a valuable blueprint for open-source developers at large. Through our shared dedication to promoting inclusivity in software development, we aim for the strategies and successes shared in this paper to inspire and guide the open-source community towards crafting more accessible software environments. Accessible HTML version of this paper is available at https://jooyoungseo.github.io/assets2023_vscode/.

CCS Concepts: • **Human-centered computing** → **Accessibility design and evaluation methods**.

Additional Key Words and Phrases: nonvisual programming, accessibility, integrated development environment, visual studio code

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1 INTRODUCTION

An integrated development environment (IDE) is an application that conveniently provides essential functions for the entire programming process, including source editing, compiling and interpreting, and debugging. IDEs have become an essential tool for not only software developers but also STEM engineers and data scientists in many fields to efficiently manage their computing environments [4, 6, 8]. However, blind developers¹ are not able to take advantage of the many features that graphical user interface (GUI)-based IDEs offer [13]. For example, syntax highlighting, code autocompletion and autosuggestion, diagnostics and linting, variable watches and breakpoints are underutilized even among experienced blind programmers,

¹We use the identity-first language (i.e., blind people) instead of the person-first language (i.e., people with visual impairments or vision loss) when addressing this population, guided by the perspective of the National Federation of the Blind.

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and many blind developers are still working manually with simple text like Notepad, along with runtime and compile terminals [2, 3, 10]. Behind this problem are intertwined issues of accessibility and learnability. Because different IDEs use different architectures and have different levels of accessibility compliance, blind developers face a new learning curve each time they use an IDE. Blind developers also face the additional challenge of learning the non-visual workaround of accessing an IDE with a screen reader [10]. Although there is a community of blind programmers called Program-L [9] where blind programmers help and support each other, IDEs remain a daunting barrier for blind people.

These difficulties are a major socio-technical barrier to blind developers reaching their full potential in the computing field and to social and professional participation. From the perspective of the social model [11], which recognizes that an individual’s disability may stem from structures and cultures that sociotechnically limit their access rather than from physical, sensory, cognitive, or emotional issues, we can see that IDE accessibility issues are no longer a group-specific problem that blind people must endure, but a collective task for the technology community to reduce barriers together. Specifically, to address these issues, blind and sighted developers need to work together to understand the challenges that blind developers face in using IDEs and then collaboratively find ways to address those challenges. This perspective is consistent with the “interdependent framework” [5, 7] that other accessibility researchers have advocated to move away from the dependency of accessibility on the individual with disabilities and instead view accessibility as a shared responsibility of people with and without disabilities and the environment surrounding them.

This paper is the empirical product of blind and sighted developers who have thought deeply about these issues and actively collaborated. We describe how the first author, who is blind, and the second author, who is sighted, have been working together to make the open source IDE Visual Studio Code (VSCode) non-visually accessible and what specific accessibility features have been implemented as a result of our collaboration. In the following sections, we start with some background on how our collaboration began, then present our methods and deliverables. Finally, we’ll share some insights from our collaboration.

2 BACKGROUND: VISUAL STUDIO CODE AND ACCESSIBILITY

Visual Studio Code is a lightweight, free, and powerful open-source code editor² which runs on the desktop and on the web. It is available for Windows, macOS, and Linux. It has built-in support for JavaScript, TypeScript, and Node.js and a rich ecosystem of extensions for other languages and runtimes (such as C++, C#, Java, Python, PHP, Go, .NET, etc.). Accessibility has been a core priority for VSCode since its inception. Among the many architectural elements of VSCode, the following, in particular, has contributed to its accessibility. First, VSCode is a cross-platform application built with the Chromium-based Electron Framework. In other words, VSCode is an application built using web technologies, which gives it the flexibility to follow web accessibility guidelines [1] and respond to the accessibility of various screen readers and assistive technologies regardless of the operating system. Second, Monaco, the primary editor of VSCode, has its own screen reader compatibility mode, which is designed to be selectively turned on and off depending on the user’s intent. Third, Microsoft’s xterm.js terminal, used by VSCode, also provides a separate screen reader accessibility switch in accordance with the Web Accessibility Guidelines. Finally, VSCode is an open-source project where anyone can suggest and fix features on GitHub, and a daily insiders version is built

²In this paper, the terms integrated development environment and code editor are used interchangeably.

so that real users can quickly use the alpha version and provide feedback to the developers, which in turn leads to a higher quality, user-centered stable version.

The accessibility benefits of VSCode and tips on how to take advantage of them have been shared among members of the Program-L mailing list, a community of blind programmers. In addition, due to its growing popularity among blind programmers, there has been a recent spate of research and development of accessible plug-ins based on VSCode [12, 16]. Nevertheless, the fact that VSCode is accessible compared to other IDEs does not necessarily mean that it is easy for blind programmers to use. For example, there is still a constant stream of questions on Program-L about VSCode, not only about its basic usage, but also about features that have already been made accessible in VSCode, such as the terminal, debugging, and the Jupyter Notebook extension, which suggests that many blind programmers are often frustrated by the tricky usability of VSCode accessibility. The following section describes how the authors of this paper collaborated to address this usability issue of VSCode accessibility.

3 METHODS

3.1 Author Profiles and Collaboration Context

The first author of this paper is blind with only light perception, currently working as an assistant professor in the School of Information Sciences at the University of Illinois at Urbana-Champaign. At the university, he teaches introductory data science courses using R and Python to undergraduate and graduate students. As a lifelong non-visual programmer, he has experience with a variety of IDEs, including Visual Studio, Eclipse, and Net Bean, and text editors such as Emacs/Emacspeak, VIM, and NotePad++, on Linux, Mac, and Windows operating systems, using a variety of screen readers (e.g., JAWS, NVDA, Narrator, VoiceOver, and Orca) and refreshable braille displays. He is a certified professional in accessibility core competencies (CPACC) from the International Association of Accessibility Professionals and has contributed code to a number of open-source data science projects to improve screen reader accessibility, including RStudio IDE Server and the web-based data science dashboard Shiny, reproducible technical publishing systems (e.g., R Markdown, bookdown, and Quarto), and the data table package gt. He is also a member of Program-L. In this community, he has experienced first-hand the challenges that blind programmers face in using IDEs and how they overcome them by interacting with other blind programmers and participating in discussions. To improve these community-wide challenges, he created his first issue on the Microsoft VSCode public GitHub site on May 31, 2020, and has since created a total of 164 contributions (87 issues; 76 post comments and mentions; 1 pull request) to actively suggest usability improvements for blind programmers in VSCode and interact with other open source developers (see Appendix Section A for more details).

The second author is a VSCode software engineer. She has worked on the product since graduating from the University of North Carolina at Chapel Hill in 2020 with the highest distinction and highest honors for her research and work with Dr. Gary Bishop on semi-automated gaming for users with a wide range of disabilities. About 10 months ago, Megan requested to take over responsibility for the product’s accessibility. Since then, she has been working closely with JooYoung and the community to understand accessibility issues and collaborate on solutions.

3.2 Co-Design and Expert Review

Our collaborative approach utilized the strategies of co-design and expert review. The co-design methodology fosters a joint creation process between the user and developer, enabling the developer to grasp the user’s requirements and, in turn, develop a product aligning with these needs [15]. In this framework, JooYoung acted as an expert, given his multi-faceted role as a regular VSCode user, an experienced open-source contributor, a data science educator, and an accessibility professional. He outlined his varied computing experiences to Megan and swiftly assessed her accessibility patches.

Their communication began asynchronously via GitHub, debating on issues and potential solutions. Following a few weeks of this pattern, they mutually agreed that scheduled meetings could prove more efficient and productive. JooYoung’s wealth of ideas and insights complemented Megan’s eagerness to learn and her drive to enhance the product’s accessibility. In these sessions, JooYoung demonstrated his use of VS Code by sharing his screen on Zoom, posing queries, and suggesting alterations. Conversely, Megan provided her insights, questioned various aspects, and noted down bugs or features requiring attention. These exchanges facilitated Megan’s understanding of JooYoung’s usage of VS Code and enabled JooYoung to comprehend the product components, which could otherwise remain confusing or undiscovered.

Despite the implementation of regular meetings, asynchronous communication via GitHub and email persisted. Megan regularly composed follow-up emails encapsulating their meeting discoveries prior to circulating them to the entire team. JooYoung further scrutinized these issues, providing comments if anything was overlooked or during the fix-testing process.

4 CO-DESIGNED DELIVERABLES

While nearly all VS Code accessibility fixes and features within the past year are products of this collaboration, below are several of the highlights.

4.1 Terminal Buffer

As discussed in Section 2, xterm.js, the terminal UI utilized by VSCode, incorporates a screen-reader accessibility mode for blind people. However, a discernible gap emerged between accessibility (the ability to access information) and usability (the convenience of use), which led to recurring concerns among blind programmers.

Consider the following scenario: you type and execute the command `echo hello; echo world;` in the terminal. You will observe `hello` and `world` as two separate lines of output. The existing accessibility mode of xterm.js presented this content through a screen reader using an aria-live alert and permitted a line-by-line review of the terminal output history with the `Ctrl+UpArrow` and `Ctrl+DownArrow` keys. This works well for short and simple outputs, but for lengthy outputs with intricate error messages or computational results, a swift speech-to-text message is insufficient for capturing substantial information in human working memory.

An additional concern is that `Ctrl+Up/DownArrow` navigation keys, designed to review terminal history, deliver the entire contents of the focused line to the screen reader as a single object. This makes detailed examination of terminal contents on a character or word basis challenging. Blind users had to switch the reading mode using the screen reader’s virtual cursor (i.e., browse mode in NVDA; QuickNav mode in

VoiceOver) to review the terminal content more thoroughly. To resume terminal input, they had to disable the virtual cursor and return to forms mode (focus mode in NVDA; QuickNav off in VoiceOver), leading to significant inconvenience.

JooYoung initiated a discussion on the official Microsoft VSCode GitHub page, bringing attention to these issues and proposing solutions (microsoft/vscode#98918: Terminal output div container should be more accessible for screen readers). Megan, meanwhile, developed terminal shell integration, a feature allowing VS Code to comprehend terminal activities, facilitating user-friendly command navigation, command output copying, and more. JooYoung demonstrated that the terminal buffer remained inaccessible for screen reader users, as it didn't support arrow key navigation. He proposed that the output view's accessible experience be integrated into the terminal. Upon discussing with a colleague, Megan incorporated the same underlying component into the terminal, making the previously inaccessible terminal buffer navigable via arrow keys for blind users.

More specifically, he suggested replacing the terminal output with a text editor buffer that supported standard arrow-key navigation. The implementation, requiring over a year of technical experimentation and collaborative testing, yielded fruitful results. Initial efforts to redirect the terminal output web container, designated as "list", to aria "document" or "textbox" landmarks proved unsatisfactory due to varying screen reader and platform support levels for aria. The terminal output was then converted into a text area with "contenteditable" and "readonly" attributes, which also did not gel with the screen reader's speech buffer. Eventually, we created a separate accessible terminal buffer by transferring the terminal output to VSCode's native Monaco editor, ensuring optimal accessibility and usability for all blind users on all platforms and screen readers. This feature, well-received by many blind users in the Program-L community, was officially introduced in the VSCode stable version 1.75. Figure 1 illustrates how the terminal buffer operates, demonstrating VoiceOver focusing on an error line in a task terminal and reading it out loud.

4.2 Git Diff and Audio Cues

Git has been around for decades as a version control tool like SVN, but its popularity has really taken off with the rise of open-source social coding platforms based on Git, such as GitHub and GitLab. Naturally, there have been many personal and social needs for blind people to utilize Git in collaborative environments. git is originally a Unix-based command-line tool, so in terms of accessibility, blind people can use a screen reader to fully utilize Git in a terminal. However, since Git has over 100 core Git commands, and the number of possible combinations could be in the millions, using Git via the command line takes a lot of effort and time to become proficient. In response, various tools have emerged that allow you to use Git as a GUI, and VSCode is a very popular IDE that supports a collaborative environment using Git.

Git provides a track changes feature that allows you to compare changes between files in an asynchronous collaborative environment, called `git diff`. Literally, the `git diff` command compares and shows the differences between a file and a file, or between a commit and a commit, with newly added lines in green and + and removed lines in red and - prefixed. VSCode had always provided an accessible `git diff` function for screen reader users. With the files or commits users want to compare open, pressing F7 (Go to Next Difference) and Shift+F7 (Go to Previous Difference) would skip to the area where the differences are, prefixing the line with the change with a + or - sign to indicate the nature of the change. Of course, this approach was fine from an accessibility standpoint, but there was room for improvement in terms of

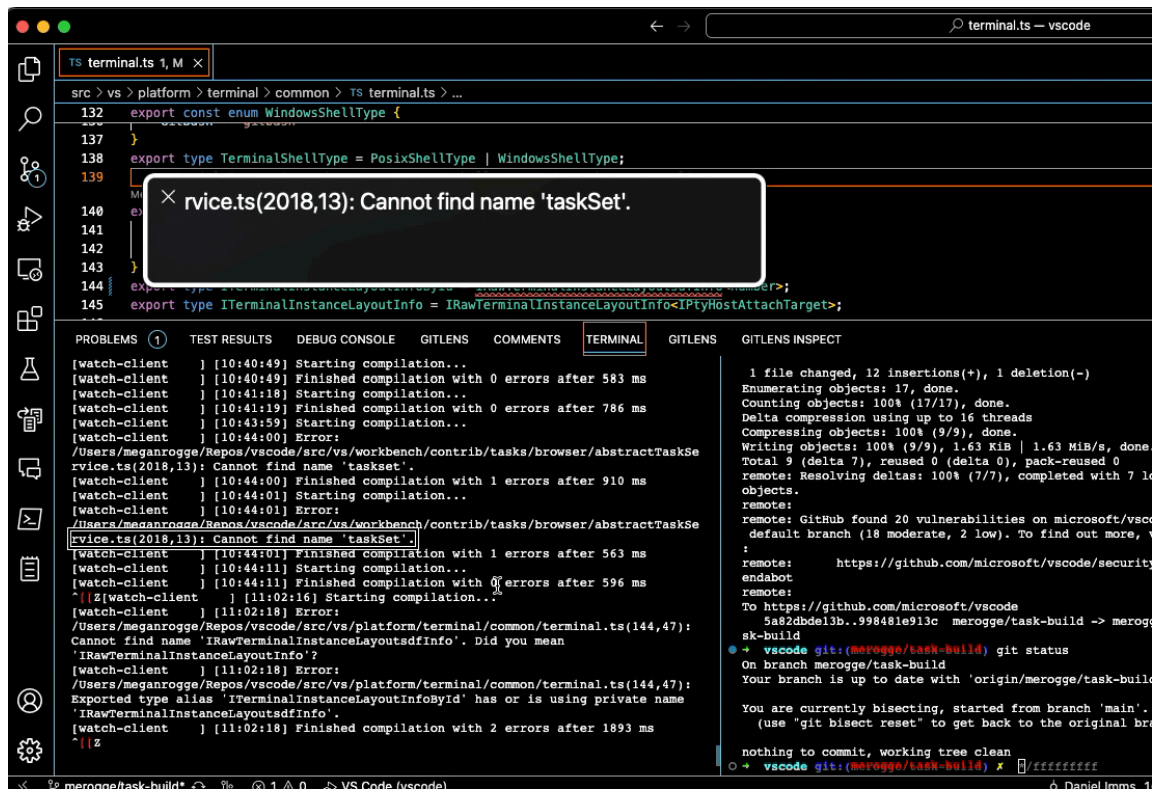


Fig. 1. VoiceOver reads “rvice.ts(2018,13: Cannot find name ‘taskSet’”

usability and convenience for blind users. For example, visual affordances like color coding and +- signs in `git diff` allowed sighted people to skim quickly, but blind people had to listen to additional speech prefixes, pronounced + (plus) and - (dash), serially and wait for information before each change. Furthermore, depending on the punctuation pronunciation settings of the screen reader, the +- sign could be omitted and delivered to the screen reader.

To address this, JooYoung suggested adding non-visual, non-speech, and audible affordances to `git diff` in addition to +- signatures, so that blind people can hear and understand them easily [microsoft/vscode#147226](https://github.com/microsoft/vscode/issues/147226): [Accessibility] Consider adding audio cues for diffs (added / deleted code). Audio cues are non-speech sound effects, an accessibility feature that VSCode and Microsoft’s other IDE, Visual Studio, have just begun to support, and TV Raman demonstrated their usefulness in non-visual programming many years ago when he developed Emacspeak, referring to them as earcons as an alternative to icons [14]. For example, audio cues allow the editor to quickly recognize if the current line of code contains an error or a warning, instead of just saying “error” or “warning” verbally, the editor will read out the unique sound associated with the error or warning. These sounds can also be delivered in parallel with text-to-speech information from a screen reader, allowing blind programmers to quickly perceive the context of the code, similar to the benefits of

quickly scanning code with different color coding for those who receive visual feedback on code with their eyes.

JooYoung had several Zoom meetings with Megan and Amnon Freidlin (Microsoft’s sound designer), and through an iterative process, finalized the three audio cues used in the `git diff` context. These were the diff line Inserted sound, which is heard when something new is added (+), the diff line Deleted sound, which is heard when something existing is removed (-), and the diff line Modified sound, which is heard when something existing is modified (+-, -+). Our success came with some trial and error. For example, an early problem was that the Diff Line Inserted and Diff Line Deleted sounds had a similar range and texture, making it difficult to distinguish between them. JooYoung realized that this was a common complaint in Program-L beyond his personal experience, so he worked with the sound designer to test and finalize a sample file that was as self-explanatory as possible and didn’t interfere with the sound of screen reader speech. Of course, we had to leave the potential issue of the static audio cues we chose not being able to adequately accommodate users with hearing impairments in certain ranges as a future work in progress, but this feature greatly improved the usability of our non-visual programming.

4.3 Verbosity Settings and Help Menus

JooYoung created issues pointing out places where minor tweaks to the order or content of an aria label could yield massive productivity improvements for screen reader users. Megan fixed some such instances and pointed team members toward others, providing guidance about best practices going forward.

Megan started self hosting with a screen reader shortly after this in order to proactively identify other problems. She felt overwhelmed by the noise and noticed some content was repeated ad nauseum, so created an issue and sought the feedback of JooYoung, who suggested that screen reader verbosity settings remedy this and a similar approach could be applied to VS Code’s aria content.

Additionally, JooYoung shared that while it was helpful to meet and learn about the new features via our meetings, most screen reader users did not have this luxury. Megan and her colleague, Daniel, brainstormed about a discoverable way for screen reader users to find out about terminal features. Upon terminal focus, an aria label conveyed how to access the terminal’s accessibility help menu. To reduce noise, this hint could be disabled with a verbosity setting. Since then, help menus and verbosity settings have been added for the Copilot inline and panel chat, notebook, and other features. For example, the terminal accessibility help menu contains helpful information for screen reader users such as commands to run (Figure 2). A screen reader user can use arrow keys to read the content line by line, character by character.

4.4 Accessibility Testing Initiative

The VS Code team tests new features at the end of every month before each release. Megan noticed that while the team tested each platform - MacOS, Linux, and Windows, they were not testing the screen reader experience. A new protocol has been established to ensure better coverage going forward; the iteration following a feature’s release, the team will test the feature using screen readers. Retroactive testing of features is currently underway to make up for this historical oversight. JooYoung’s creation of issues about old and new features alike inspired and justified this initiative.

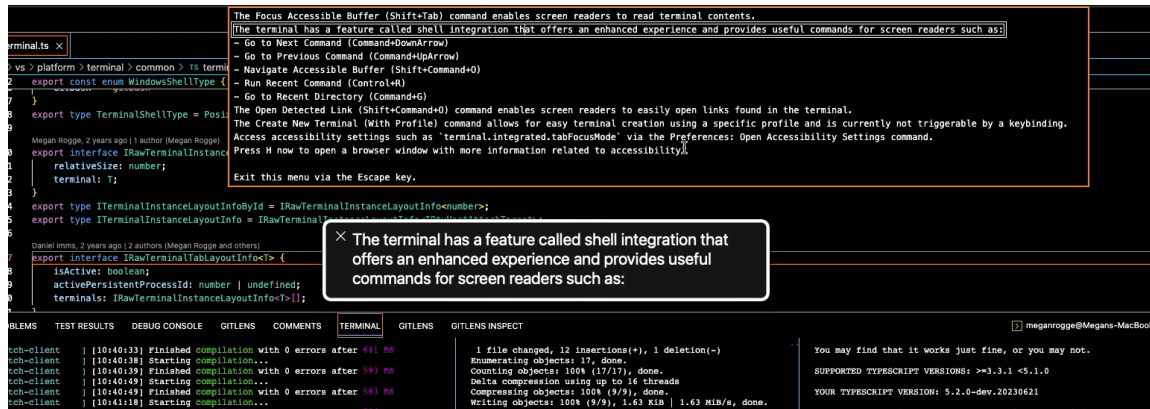


Fig. 2. A line in the help menu is focused and VoiceOver reads “The terminal has a feature called shell integration that offers an enhanced experience and provides useful commands for screen readers such as:”

5 DISCUSSION AND CONCLUSION

Our ongoing collaboration between sighted and blind developers underlines the importance and potential of improving accessibility in open-source tools, specifically illustrated by our work on Visual Studio Code. A notable success is the terminal accessible buffer, a solution initially created for screen reader users, that proved to be beneficial for a wider user base as seen here. Furthermore, knowledge sharing, epitomized by Megan and JooYoung’s livestream presentation, is a cornerstone in promoting an inclusive, democratic coding and programming culture.

The urgency of addressing accessibility early in the development process has been a vital lesson from our collaboration. Postponing such efforts can create significant barriers for screen reader users, therefore prioritizing these enhancements is crucial.

Moreover, we are enthusiastically working on Copilot, an AI-based, Language Model (LLM) feature, with a dedicated focus on its accessibility for blind programmers. Anticipating the considerable potential of Copilot, we are committed to ensuring that blind programmers can utilize this technology without delay, rather than having to wait for subsequent accessibility improvements.

Drawing these threads together, our co-design efforts emphasize the necessity of creating a more equitable coding environment where all programmers, regardless of their disabilities, can participate fully. Our ongoing engagement and activities on GitHub aim to serve as a motivation and guide for other open-source developers towards similar endeavors of inclusive development.

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A APPENDIX: VSCODE ACCESSIBILITY DISCUSSIONS ON GITHUB

The following are JooYoung’s GitHub contributions, including issues, pull requests, comments, and mentions, related to accessibility up to the time of this paper’s submission.

```
$ gh search issues --repo microsoft/vscode --include-prs --involves jooyoungseo -L 200
```

issue	microsoft/vscode	186857	open	[Accessibility] Checkboxes are unlabeled in `Export Profile...` bug, accessibility
issue	microsoft/vscode	186754	open	data science audio and text graph for visually impaired person feature-request
issue	microsoft/vscode	186679	open	Alert that the help hint has been disabled bug, accessibility 2023-06-09T23:22:27Z
issue	microsoft/vscode	186678	open	Change accessible buffer command navigation keybinding for screen reader feature-request
issue	microsoft/vscode	186676	open	add accessible view provider for inline chat response feature-request
issue	microsoft/vscode	186675	open	when next/previous ghost text suggestion is shown, we don't alert screen reader feature-request
issue	microsoft/vscode	186673	closed	have accessible view for ghost text completions feature-request, accessibility
issue	microsoft/vscode	186659	closed	Sticky scroll for screen reader users feature-request, accessibility
issue	microsoft/vscode	186514	closed	Closing accessibility hint doesn't stop VoiceOver from reading it bug, accessibility
issue	microsoft/vscode	185705	closed	Consider providing screen reader with the chat response for inline chat feature-request
issue	microsoft/vscode	185691	closed	Consider which audio cues for chat experience should be enabled by default feature-request
issue	microsoft/vscode	185565	open	Accessibility: Cannot turn off audio cues on a language level feature-request
issue	microsoft/vscode	185371	open	Review usage of `aria-live: assertive`, `alert` throughout the code base feature-request
issue	microsoft/vscode	185155	open	Alert screen reader users that something has occurred when `clear` is used feature-request
pr	microsoft/vscode	185153	merged	prevent screen reader from reading a user's chat request on enter 2023-06-09T23:22:27Z
issue	microsoft/vscode	184357	open	[Accessibility]: Make syntax highlight accessible to screen reader users feature-request
issue	microsoft/vscode	184176	closed	Add notebook accessibility help menu feature-request, verified, accessibility
issue	microsoft/vscode	184173	closed	Accessibility: Take out extra messages from Notebook verbosity FALSE feature-request
issue	microsoft/vscode	183567	open	Explore improvements to notifications when using a screen reader accessibility
issue	microsoft/vscode	183363	closed	Make accessibility help generic feature-request, accessibility, on-test
issue	microsoft/vscode	183030	closed	Reading suggestions or autocomplete of extensions bug, verified, accessibility
issue	microsoft/vscode	182682	open	Merge editor accessibility accessibility, merge-editor 2023-06-21T12:35:23Z
pr	microsoft/vscode	182666	merged	outweigh normal editor accessibility help menu 2023-06-30T23:23:35Z
issue	microsoft/vscode	181732	closed	Accessibility: Make drag-and-drop accessible via keyboard bug, accessibility
issue	microsoft/vscode	181139	open	Accessibility: Make Tab key focus restricted to the currently open view feature-request
issue	microsoft/vscode	181060	closed	BAccessibility: Pressing Shift+Tab key in Ctrl+F moves to terminal area feature-request
issue	microsoft/vscode	180970	closed	provide alt text for image outputs feature-request, accessibility, verified
pr	microsoft/vscode	180776	merged	fix windows quick fixes 2023-06-09T23:22:27Z
issue	microsoft/vscode	180729	closed	Investigate merge editor accessibility bug, accessibility 2023-05-23T12:35:23Z
issue	microsoft/vscode	180725	open	interacting with components should be consistent accessibility, extended
issue	microsoft/vscode	180653	closed	[Accessibility]: Present content first in References Treeview help wanted
issue	microsoft/vscode	180221	open	Accessibility: Ctrl+Down/UpArrows does not work in Tree find control feature-request
issue	microsoft/vscode	180216	closed	[Accessibility]: Typing characters does not move focus in File Explorer feature-request
issue	microsoft/vscode	180176	open	[Accessibility]: Consider replacing audioCues.lineHasInlineSuggestion with audioCues.lineHasFocus feature-request
issue	microsoft/vscode	180083	open	Accessibility: Make Debug Console follow terminal tabFocusMode accessibility
issue	microsoft/vscode	180049	open	[Accessibility]: Support filtering symbol types in Document Symbol View feature-request
issue	microsoft/vscode	179981	open	Focus does not stay in the editor area after sending selection to terminal feature-request
issue	microsoft/vscode	179979	closed	Accessibility: Ctrl+Up/DownArrows does not work in terminal created in editor feature-request

573	issue	microsoft/vscode	179970	closed	Accessibility: Make Ctrl+RightArrow expand all in tree views
574	issue	microsoft/vscode	179969	closed	Make filtering more flexible in Problem View info-needed, er
575	issue	microsoft/vscode	179967	open	Accessibility: Generalize Ctrl+DownArrow and Ctrl+UpArrow to al
576	issue	microsoft/vscode	179964	open	Accessibility: Improve Problem View search input accessibili
577	issue	microsoft/vscode	179718	closed	search result aria label should prioritize content over location
578	issue	microsoft/vscode	179717	closed	Problems aria label should prioritize content over location fea
579	issue	microsoft/vscode	179716	open	Allow configuring what is included in the accessible buffer fea
580	issue	microsoft/vscode	179283	closed	[Accessibility]: Make "Go to line" announce focused line after
581	issue	microsoft/vscode	179272	closed	[Accessibility]: Add shortcut keys to jump between executed com
582	issue	microsoft/vscode	179123	closed	[Accessibility]: `Search: Find in Files, Control+Shift+F` could
583	issue	microsoft/vscode	178935	closed	[Accessibility] Audio cues stopped working in Chrome accessi
584	issue	microsoft/vscode	178915	closed	[Accessibility] Make sticky scroll view line indentation access
585	issue	microsoft/vscode	177755	closed	[Accessibility]: Switching editor (Ctrl+Tab) does not work from
586	issue	microsoft/vscode	177697	closed	`Terminal: navigate accessible buffer` does not work sometimes
587	issue	microsoft/vscode	177696	closed	Inline suggestion is read twice by the screen reader bug, ve
588	issue	microsoft/vscode	177694	closed	add command to repeat most recent notification accessibility,
589	issue	microsoft/vscode	177029	closed	[Accessibility]: `Set Selection Anchor` and `Select from Anchor
590	issue	microsoft/vscode	176779	open	Make error in line audio cue configurable feature-request, ac
591	issue	microsoft/vscode	176521	open	[Accessibility] Support task completion/failure audio cues in C
592	issue	microsoft/vscode	176293	closed	Prefer SVG renderers for image output to improve screen reader
593	issue	microsoft/vscode	176292	open	improve screen reader context and navigation of Cell outputs
594	issue	microsoft/vscode	176290	open	consider default keybindings for go to next / previous cell inp
595	issue	microsoft/vscode	176286	closed	`allowNavigateToSurroundingCells` should be false when screen r
596	issue	microsoft/vscode	176242	open	Notify screen reader users that a VS Code update is available
597	issue	microsoft/vscode	175986	open	Allow VS Code extensions to trigger audio cues feature-request
598	pr	microsoft/vscode	175823	merged	provide screen reader with inline suggestions 2023-04-21T23:2
599	issue	microsoft/vscode	175743	open	Output of Jupyter notebook cells is not intuitively accessible
600	issue	microsoft/vscode	175432	closed	[Accessibility] Pressing Ctrl+M key (toggle tabFocusMode) shoul
601	issue	microsoft/vscode	175348	open	Refine error on line audio cue feature-request, accessibility
602	issue	microsoft/vscode	175341	closed	[Accessibility] Some thoughts on error in line audio cue bug
603	issue	microsoft/vscode	175282	open	[Accessibility] Do not use title attribute when labeling button
604	issue	microsoft/vscode	175177	closed	[Accessibility] Remove repeated word from the terminal help bug
605	issue	microsoft/vscode	175175	closed	[Accessibility] "Go to Recent Directory (Control+G)" instructio
606	issue	microsoft/vscode	175162	closed	assign different default keybinding for focusing the accessible
607	issue	microsoft/vscode	175140	closed	Add a command that accepts a notification's default action fea
608	issue	microsoft/vscode	175111	closed	[Accessibility] Redundant read-only terminal buffer needs to be
609	issue	microsoft/vscode	175105	closed	[Accessibility] Reconsider the UI design for {"editor.screenRea
610	issue	microsoft/vscode	175014	closed	Replace diff line modified/deleted/ inserted audio cues with pu
611	issue	microsoft/vscode	175013	closed	On focus of the accessible buffer, if the last command failed,
612	issue	microsoft/vscode	175012	closed	Use more succinct audio cue when terminal command fails feature

625	issue	microsoft/vscode	175011	closed	position the cursor at the end of the accessible buffer by default	bug
626	issue	microsoft/vscode	174857	closed	[Accessibility] Line-by-line audio cues are not played when column position changes	
627	issue	microsoft/vscode	174800	closed	[Accessibility] Shift+Tab is always forced to go to a11y terminal buffer	
628	issue	microsoft/vscode	174798	closed	[Accessibility] Remove redundant 4-5 blank lines from the terminal a11y buffer	
629	issue	microsoft/vscode	174797	closed	[Accessibility] python repl content is not parsable in the a11y terminal buffer	
630	issue	microsoft/vscode	174793	closed	[Accessibility] Consider adding a setting to preserve focus in a11y terminal buffer	
631	pr	microsoft/vscode	174606	merged	add setting for aria-live assertive alert for ghost text	2023-04-07T14:44:44Z
632	issue	microsoft/vscode	174368	closed	Play audio cue when a command exits with non-zero code	feature-request, verified
633	issue	microsoft/vscode	174367	closed	Mention `Terminal: Create Terminal with Profile` in terminal a11y help	
634	issue	microsoft/vscode	174365	closed	Suggest screen reader users migrate from `cmd prompt` -> `pwsh` feature-request	
635	issue	microsoft/vscode	174362	open	Next suggestion isn't read	bug, accessibility 2023-03-13T09:34:44Z
636	issue	microsoft/vscode	174360	open	When in `tabFocusMode`, assign a different keybinding for inline suggestions	
637	issue	microsoft/vscode	174359	open	Add more audio cues	feature-request, accessibility 2023-03-02T16:46:51Z
638	issue	microsoft/vscode	174079	closed	Add symbol provider for terminal accessible buffer	feature-request, verified
639	issue	microsoft/vscode	173622	closed	No indication of ghost text and actions via screen reader	accessibility, verified
640	issue	microsoft/vscode	173532	closed	I can no longer access terminal accessibility buffer with orca	bug, verified
641	issue	microsoft/vscode	173452	closed	[Accessibility] Add page up/down support for accessible buffer	feature-request, verified
642	issue	microsoft/vscode	173451	closed	[Accessibility] Make `editor.action.toggleTabFocusMode` configurable in settings	
643	issue	microsoft/vscode	172606	closed	[Accessibility] Go to next/previous change commands don't provide delete option	
644	issue	microsoft/vscode	172582	closed	[Accessibility] Terminal a11y buffer is not automatically updated	bug, verified
645	issue	microsoft/vscode	172525	closed	[Accessibility] Error audio cues are not played on a character level.	
646	issue	microsoft/vscode	172523	closed	[Accessibility]: Audio Cues are not played against swift arrow navigation	
647	issue	microsoft/vscode	172465	closed	Reduce noise for screen reader users	feature-request, verified, accessibility
648	issue	microsoft/vscode	172458	closed	in diff view, line selection shouldn't happen on cursor move	bug, verified
649	issue	microsoft/vscode	172399	closed	tab has to be pressed twice to go back to the terminal buffer from accessible buffer	
650	pr	microsoft/vscode	172276	merged	xterm@5.2.0-beta.21	2023-03-11T23:23:27Z
651	issue	microsoft/vscode	172204	closed	Screen reader accessibility mode reads terminal contents character by character	
652	issue	microsoft/vscode	172149	open	[Accessibility] Command history is not readable in terminal input field	
653	issue	microsoft/vscode	172024	closed	[Accessibility] Ctrl+M (editor.action.toggleTabFocusMode) does not work	
654	issue	microsoft/vscode	172007	closed	Terminal accessibility buffer does not read output upon enter	bug, verified
655	issue	microsoft/vscode	172006	closed	Make terminal accessibility buffer read only	upstream, accessibility
656	issue	microsoft/vscode	171918	closed	[Accessibility] Support Home and End keys in Open Detected Link view	
657	issue	microsoft/vscode	171916	closed	[Accessibility] Ctrl+Shift+0 does not close Open Detected Link view	as expected
658	issue	microsoft/vscode	171914	closed	[Accessibility] Make terminal a11y buffer even more accessible	accessibility
659	issue	microsoft/vscode	171755	open	Code lens is not accessible via screen reader	accessibility, under-diff
660	issue	microsoft/vscode	171544	closed	sometimes audio cues don't play when going to next/previous difference	
661	issue	microsoft/vscode	171429	closed	[Accessibility] Diff editor cursor position is not preserved after escape	
662	issue	microsoft/vscode	171426	open	[Accessibility] Diff editor cursor position is not preserved after escape	
663	issue	microsoft/vscode	171256	closed	[Accessibility] Trigger diff audio cues against standard arrow key navigation	
664	issue	microsoft/vscode	171253	open	[Accessibility] Allow users to customize the audio cue play priority	

677	issue	microsoft/vscode	171200	closed	support screen reader reading the line and audio cues when go t
678	issue	microsoft/vscode	171199	open	Accessibility getting started experience feature-request, ac
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680	pr	microsoft/vscode	170985	merged	support screen reader reading the line when go to next/previous dif
681	issue	microsoft/vscode	170971	closed	[Accessibility]: Allow users to replace default sound file *du
682	issue	microsoft/vscode	169853	closed	Explore plain content editable element for terminal buffer inst
683	issue	microsoft/vscode	168746	open	[Accessibility] Word wrap does not work in diff view (F7 and Sh
684					
685	pr	microsoft/vscode	167349	closed fix	#167348: add aria-live 2023-02-16T17:31:02Z
686	issue	microsoft/vscode	167348	closed	[Accessibility] div.monaco-tokenized-source requires aria-live=
687	issue	microsoft/vscode	168814	open	Need a clearer landmark and label for notebook output area fea
688	issue	microsoft/vscode	166518	closed	Add audio cues for Go to Next/ Previous Change commands feature
689	issue	microsoft/vscode	166472	open	[Accessibility] Add an option to allow Alt+F5 to jump to the ne
690	issue	microsoft/vscode	165863	closed	Hitting spacebar does not replay currently focused audio cue
691	issue	microsoft/vscode	165357	closed	[Accessibility] Audio Cues still doesn't work in github.dev ins
692	issue	microsoft/vscode	165161	open	[Accessibility] Open Folder dialog controls do not have acceler
693	issue	microsoft/vscode	165161	open	[Accessibility] Open Folder dialog controls do not have acceler
694	issue	microsoft/vscode	164988	closed	[Accessibility]: Screen readers do not read currently focused l
695	issue	microsoft/vscode	163506	open	[Accessibility] Provide icon info to screen readers feature-req
696	issue	microsoft/vscode	160301	open	[Accessibility] Some long file content line is not correctly co
697	issue	microsoft/vscode	159029	open	Merge editor accessibility improvements accessibility, merge-ed
698	issue	microsoft/vscode	155919	closed	[Accessibility] Support `Live Share` audio cues in `Help: List
699	issue	microsoft/vscode	155655	closed	[Accessibility] For easier code navigation, add jump to next/pr
700	issue	microsoft/vscode	154027	closed	[Accessibility]: Terminal output is not read in real time on Ma
701	issue	microsoft/vscode	147607	closed	[Accessibility] Unlabelled `codicon` buttons info-needed, ac
702	issue	microsoft/vscode	147386	closed	[Accessibility] Add audio cues for indentation levels feature
703	issue	microsoft/vscode	147230	open	Play audio-cues for auto-suggestions feature-request, access
704	issue	microsoft/vscode	147226	closed	[Accessibility] Consider adding audio cues for diffs (added / d
705	issue	microsoft/vscode	147190	closed	[Accessibility] Audio Cues doesn't work in web editor bug, ve
706	issue	microsoft/vscode	143185	closed	Problems to access the preview of a markdown file using orca
707	issue	microsoft/vscode	142983	closed	[Terminal accessibility] JAWS does not speak anything against a
708	issue	microsoft/vscode	141529	closed	Webviews displaying results of an API call with Restclient exte
709	issue	microsoft/vscode	135920	closed	[Accessibility] "xterm-accessibility" class div does not have t
710	issue	microsoft/vscode	135035	closed	[Accessibility] GitHub Web Editor: Cannot configure accessibili
711	issue	microsoft/vscode	133876	closed	[Accessibility] Assign a keyboard shortcut key to Focus Termina
712	issue	microsoft/vscode	133805	closed	`Shift+Alt+R` for `Reveal in File Explorer` doesn't work when f
713	issue	microsoft/vscode	133773	closed	[Accessibility] "document" role is needed for "monaco-hover" cl
714	issue	microsoft/vscode	132275	closed	[Accessibility] Add "document" role to webview widget verific
715	issue	microsoft/vscode	131295	open	[Accessibility] Character is not read properly in terminal input
716	issue	microsoft/vscode	131090	closed	[Accessibility] NVDA and JAWS do not read focused auto-suggesti
717	issue	microsoft/vscode	130565	closed	Notify Screenreader Users When Inline Suggestions Or Decoration
718	issue	microsoft/vscode	121735	closed	Terminal input does not work with NVDA bug, important, accessi
719	issue	microsoft/vscode	113482	closed	Tab code-completion does not work in terminal input against scr
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729	issue	microsoft/vscode	111255	open	VS Code native notebook accessibility improvement	debt, accessibility
730	issue	microsoft/vscode	105425	closed	Garbage characters are inserted if you come back from terminal output t	
731	issue	microsoft/vscode	103095	closed	Auto-complete popup puts redundant "item" prefix per suggested code for	
732	issue	microsoft/vscode	98918	closed	Terminal output div container should be more accessible for screen read	
733	issue	microsoft/vscode	95570	closed	Support terminal link keyboard navigation	feature-request, accessibility
734	issue	microsoft/vscode	90408	open	Feature request: Accessibility support for Jupyter notebooks in VSCode	
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