

CHAPTER 7

Assistive Technologies

For people without disabilities, technology makes things easier. For people with disabilities, technology makes things possible.

—IBM Training Manual 1991

Do you wear glasses or contacts? You may not think about those things as assistive technology but in many ways they are. They make things more accessible to you. Creating accessible experiences, often times, can open our eyes to things that we didn't know existed with the technology we use on a daily basis. The beauty of technology is that it can be made for all of us. Accessibility often ends up benefitting all of us and allows for ease of use with our products.

In this chapter, we'll start with a brief overview of assistive technologies and then look at several assistive technologies and how they assist people with disabilities and their experiences. More resources can be found in the appendix.

Who, What, Where, When, Why, and How

In application of the W5H (who, what, where, when, why, and how), assistive technologies is the what. As creators, having knowledge of the different types of assistive technologies one might use, can help you understand how people might use your products or services.

When you think about the individuals who will use your product, you can ask yourself the following questions: Are they accessing your product via Web, mobile, or a voice assistant? What are they using to access your product?

It's good to take a look out there and see what is happening. I Googled "Assistive Technologies for tech", and got the results shown in Figure 7-1.



Figure 7-1. Google search of Assistive Technology for tech

What Is Assistive Technology?

Assistive technology (AT) is a general term that includes assistive, adaptive, and rehabilitative devices for people with disabilities, including the process used in selecting, locating, and using them. Assistive technology promotes greater independence by enabling people to perform tasks that they were formerly unable to accomplish, or had great difficulty accomplishing, by providing enhancements to, or changing methods of interacting with, the technology needed to accomplish such tasks. Assistive technology products are designed to provide additional accessibility to individuals who have physical or cognitive difficulties,

impairments, and disabilities. There are so many instances where, through minor modifications, you can make a mainstream product accessible. Nevertheless, there are also situations where your only option is assistive technology.

Adaptive Technology vs. Assistive Technology

The term adaptive technology is often used as the synonym for assistive technology; however, they are different terms. **Assistive technology** refers to “**any item, piece of equipment, or product system, whether acquired commercially, modified, or customized,** that is used to increase, maintain, or improve functional capabilities of individuals with disabilities,” while **adaptive technology covers items that are specifically designed for persons with disabilities and would seldom be used by nondisabled persons.**

If you have a disability or injury, you may use a number of assistive devices or rehabilitation equipment to aid you in and around the home. Assistive devices are tools, products, or types of equipment that help you perform tasks and activities if you have a disability or injury or are a senior. Assistive devices may help you move around, see, communicate, eat, or get dressed/undressed.

Assistive devices for mobility/ambulation can also be referred to as ambulatory aids. Ambulatory aids (e.g., **canes, crutches, walkers**) are used to provide an extension of the upper extremities to help transmit body weight and provide support for the user.

Assistive devices can help you improve your quality of life and maintain your sense of independence.

Well-designed high-quality assistive devices, or daily living aids, that support independent living for the disabled, seniors, or those with a medical condition or injury should make life easier and safer for the aged and disabled.

AT promotes greater independence by enabling people to perform tasks that they were formerly unable to accomplish, or had great difficulty

accomplishing, by providing enhancements to or changed methods of interacting with the technology needed to accomplish such tasks.

An assistive device could be a wheelchair, reacher, or a disability product that allows you to use a computer. If you experience difficulties performing certain tasks, it is possible that an assistive device can help you overcome your problems.

Other disability aids include

- Advanced technology walking products to aid people with disabilities, such as paraplegia or cerebral palsy, who would not at all be able to walk or stand (exoskeletons)
- Standing products to support people with disabilities in the standing position while maintaining/improving their health (standing frame, standing wheelchair, active stander)
- Seating products that assist people to sit comfortably and safely (seating systems, cushions, therapeutic seats)
- Walking products to aid people with disabilities who are able to walk or stand with assistance (canes, crutches, walkers, gait trainers)
- Wheeled mobility products that enable people with reduced mobility to move freely indoors and outdoors (e.g., wheelchairs and scooters)

Certain devices, such as eyeglasses and hearing aids, obviously require an expert's assessment, but many assistive devices for the enhancement of daily life such as wheelchairs, walkers, bath seats, and grab bars are easily obtainable in general and specialty stores including online disability product web sites.

You will also find pharmacy personnel are usually quite happy to provide information on a variety of other assistive products like magnifying glasses, bath seats, joint support bandages, pill organizers, canes, etc.

Specialty computer stores often carry items like **screen reading software** that include **screen enlargement features** for persons with vision impairments. **Voice recognition systems, modified keyboards, and computer mice** are also available for people with mobility and dexterity limitations.

When selecting assistive technology products for computers, it is **crucial to find the right products that are compatible with the computer operating system and programs** on the particular computer you will be using.

Screen Readers

Screen readers are software that can live within a device such as computers and mobile devices. Figure 7-2 shows how a user interacts with a screen reader. Notice that first the screen reader identifies text or graphics, then the screen reader navigates the page, then screen readers read text or graphics, then the keyboard or voice is used to navigate the web page, and finally text or graphics are read back to the user as speech or braille.

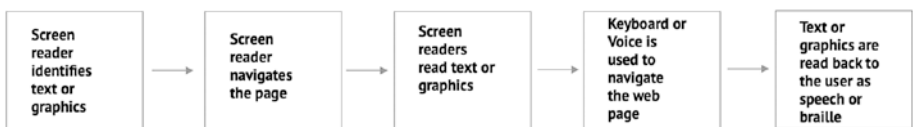


Figure 7-2. *User flow of screen reader*

The following are some example of the types of software available:

- **Screen readers:** Software used by blind or visually impaired people to read the content of the computer screen. Examples include JAWS for Windows, or NVDA. Figure 7-3 shows JAWS (Job Access With Speech) screen reader software, the world's most popular screen reader, developed for computer users whose vision loss prevents them from seeing screen content or navigating with a mouse.¹



Figure 7-3. *JAWS screen reader software*

- **Screen magnification software:** Allow users to control the size of text and or graphics on the screen. Unlike using a zoom feature, these applications allow the user to have the ability to see the enlarged text in relation

¹Freedom Scientific JAWS Logo www.freedomscientific.com/products/software/jaws/

to the rest of the screen. This is done by emulating a handheld magnifier over the screen. The American Federation for the blind has a few recommendations for free alternatives.² Figure 7-4 shows a screen magnifier called Dragnifier.

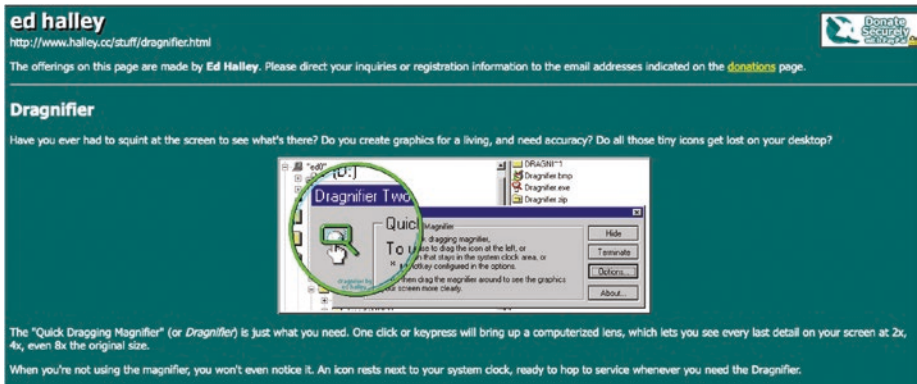


Figure 7-4. Ed Halley's screen magnifier "Dragnifier"

- **Zoom-in browsers** can help those with vision impairments see text and images on the screen. Figure 7-5 shows an Amazon home page magnified 400% on Chrome.

²A review of Freeware and Shareware screen magnification software for Windows www.afb.org/aw/14/4/15707

Handbrowsers not always
mobile only

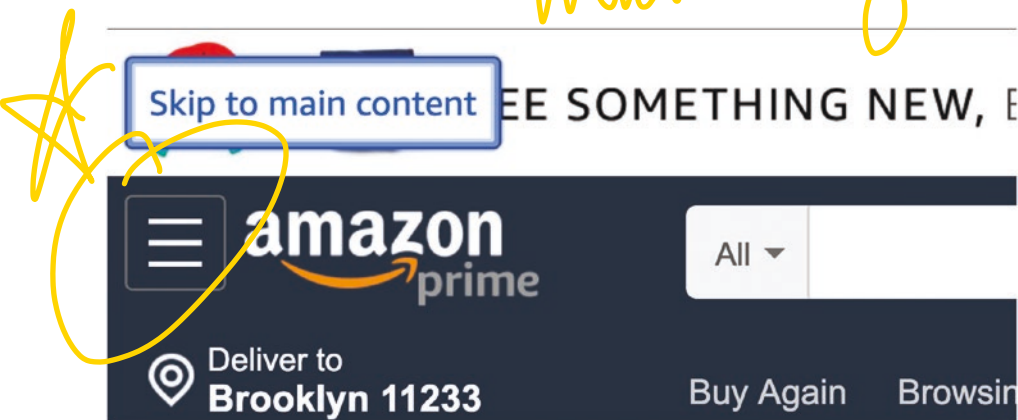


Figure 7-5. Image of Amazon home page magnified at 400%

- **Text readers:** Software used by people with various forms of learning disabilities that affect their ability to read text. This software will read text with a synthesized voice and may have a highlighter to emphasize the word being spoken. These applications do not read things such as menus or types of elements—they only read the text. Figure 7-6 shows one of the more popular text readers: Natural Readers.

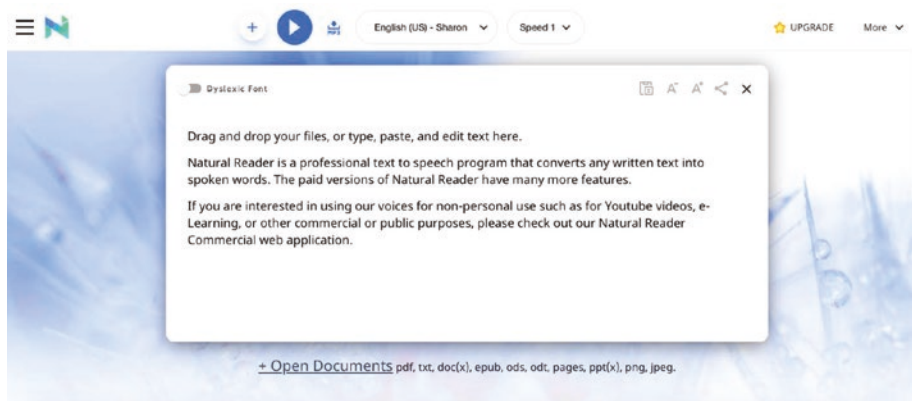


Figure 7-6. Natural Readers instructions for their text reader
www.naturalreaders.com/online/

- **Speech input software:** Provides people with difficulty in typing an alternate way to type text and also control the computer. Users can give the system some limited commands to perform mouse actions. Users can tell the system to click a link or a button or use a menu item. Please note both Windows and Mac have some speech recognition utilities, but they cannot be used to browse the Web. Figure 7-7 shows Apple's voice-over feature, which is available for Apple devices.

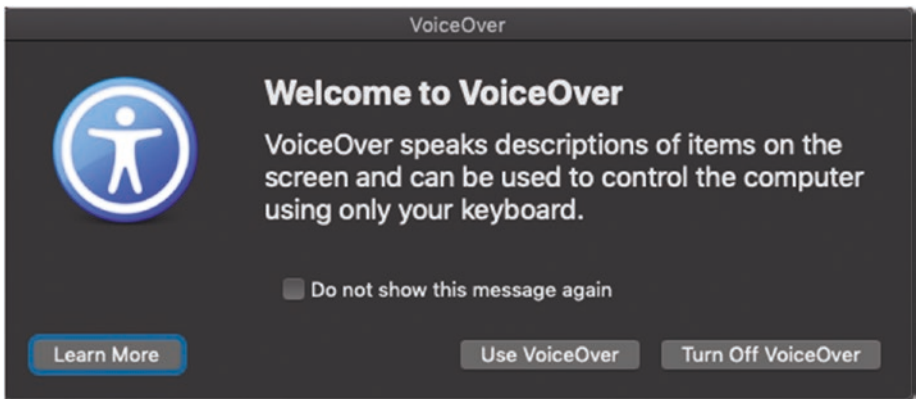


Figure 7-7. Voice-over pop-up on Apple computer

- **Alternative input devices:** Some users may not be able to use a mouse or keyboard to work on a computer. These people can use various forms of devices, such as
 - **Head pointers:** A stick or object mounted directly on the user's head that can be used to push keys on the keyboard. This device is used by individuals who have no use of their hands. Figure 7-8 shows a head pointer and stylus.



Figure 7-8. Head pointer and stylus headband edition www.unitedspinal.org/disability-products-services/mundstab-mouthstick---mouth-head-sticks/

- **Motion tracking or eye tracking:** This can include devices that watch a target or even the eyes of the user to interpret where the user wants to place the mouse pointer and moves it for the user. Figure 7-9 shows an eye with the camera and the gaze of the user's eyes.

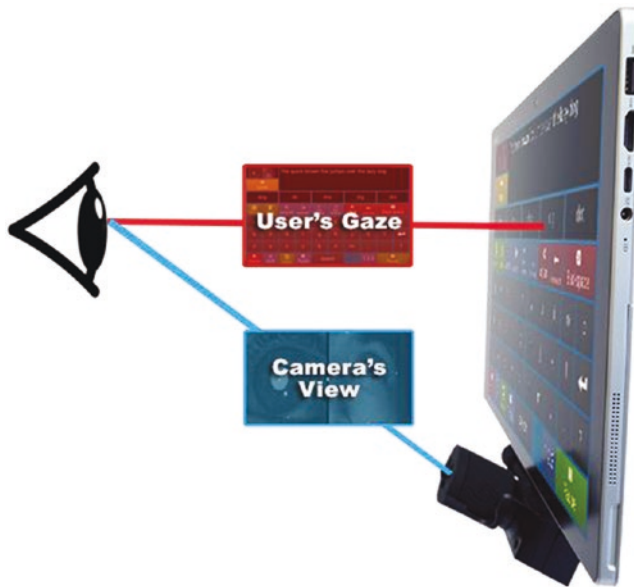


Figure 7-9. Eyegaze eye-driven tablet communication system
<https://eyegaze.com/products/eyegaze-edge/>

- **Single switch entry devices:** These kinds of devices can be used with other alternative input devices or by themselves. These are typically used with on-screen keyboards. The on-screen keyboard has a cursor move across the keys, and when the key the user wants is in focus, the user will click the switch. This can also work on a web page: the cursor can move through the web page, and if the user wants a to click a link or button when that link or button is in focus, the user can activate the switch. Figure 7-10 shows a switch controller in yellow and white.



Figure 7-10. Switch controller www.boundlessat.com/Switches

Some assistive technologies are built into devices and some are stand-alone technologies that work along with web browsers.

Web browsers have built in accessibility that will work with assistive technologies. In the next section, we will look at some of the most used web browsers and the accessibility features they have available.

Web Browsers

In 2019, the top browsers in the United States for searching the Web are³

- Mozilla Firefox
- Google Chrome
- Opera
- Microsoft Edge
- Microsoft Internet Explorer

If you do not currently use the accessibility features, you may not know what is available for people with disabilities. For each browser, there are

³Top five web browsers www.techradar.com/news/the-best-web-browser

different accessibility features, which are available for people's individual needs. Let's take a look at some of Mozilla's accessibility features.

Mozilla is widely used and is the number one browser in the United States. It has a lot to offer! Firefox includes many features to make the browser and web content accessible to all users including those who have low vision, no vision, or limited ability to use a keyboard or mouse.⁴

This section will cover keyboard use, mouse shortcuts, using high-contrast theme, controlling web content, and compatibility with assistive technologies.

Looking these over also gives you an opportunity to try these accessibility features on your own.

Keyboards

There are folks who may only use a keyboard to navigate web pages. Understanding the way different browsers work with keyboard navigation can be helpful when creating experiences. Let's take a look at Firefox.

Using a Keyboard to Navigate Within Web Pages

In your Firefox Preferences in the General panel, the *Browsing* section includes the setting **Always use the cursor keys to navigate within webpages** which allows you to move through web content as if you were inside a read-only editor. You can use the keyboard to select web content and copy it to the clipboard.

You can press F7 at any time to turn this feature on or off. When you press F7, Firefox will ask if you really want to turn on this feature. You can disable this prompt by selecting **Do not show this dialog again**.

⁴Accessibility features in Firefox—make Firefox and web content work for all users <https://support.mozilla.org/en-US/kb/accessibility-features-firefox-make-firefox-and-we>

Searching for Text When You Start to Type

In your Firefox Preferences in the General panel, the *Browsing* section includes the setting **Search for text when you start typing**. This allows you to quickly navigate to text or hyperlinks in a web page. This feature has two modes. Press / and start typing to search all text on the current page, or press ' before your string to search hyperlinks only. Firefox will highlight matching text or hyperlinks as you type.

The following keyboard shortcuts control this feature:

- Type more characters to narrow your search. Firefox will highlight the next matching hyperlink or text or alert you that nothing matched.
- Press command+G or F3 to find the next occurrence of your current search string.
- Press command+Shift+G or Shift+F3 to find the previous occurrence of your current search string.
- Press Backspace to undo the last character you typed. Firefox will back up to the previously highlighted text.
- Press Esc to cancel a search. You can also cancel a search by changing focus or simply waiting for the timeout.

HTML Access Keys

On some web pages, keyboard shortcuts are assigned to different elements on the page. To move the cursor directly to one of these elements, press Ctrl + option + AccessKey.

Which key AccessKey is depends on the web site. It is determined by the web site author, not Firefox.

Zoom, Fonts, and Colors

You can zoom in and out of web pages including images with the following keyboard shortcuts:

- Press command++ to display the web page one size larger.
- Press command+- to display the web page one size smaller.
- Press command+0 (zero) to display the web page at its normal size.

You can choose to change the text size only using the *Text Zoom* feature:

1. On the menu bar, click the View menu, and then go to Zoom.
2. Select Zoom Text Only, which will make the controls only apply to text, not images.

The following keyboard shortcuts control text size when Text Zoom is selected:

- Press command++ to increase the text size.
- Press command+- to decrease the text size.
- Press command+0 (zero) to reset the text size to the web page's default size.

Note that some web pages may display incorrectly if you increase or decrease the text size.

Other accessibility features on Mozilla Firefox include

- Setting fonts and colors
- Setting a minimum font size

- Overriding page fonts
- Overriding page colors
- Blocking pop-up windows
- Restricting JavaScript behavior

Try This

–

Use the zoom feature (go up to 400%) on your browser and see if you can navigate the page.

The other browsers like Mozilla have accessibility features built in that can be used with assistive technologies. The full list of links to resources for these features can be found in the appendix.

Mobile

We live in an Android and iOS world when it comes to our devices. Both sets of devices have accessibility built into them. Table 7-1 lists the accessibility features for the latest phones side by side.

Table 7-1. *Mobile phone accessibility features*

Features	iOS Accessibility Features for Mobile	Android Accessibility Features for Mobile
Modification of Text	X	X
Screen Magnification	X	X
Digital Pay Systems	X	X
Screen Readers	X	X
Color Inversion	X	X

When it comes to features, both Android and iOS measure almost equally. However, when it comes to ease of use, many have said that iOS is a lot easier to use. Ultimately, what is best for you is the best.

In recent years, we have seen an emergence in Voice User Interfaces (VUI). Alexa, Google, and Cortana have been weaved into our lives, and we now consider the use of voice assistants in our home the new normal.

Having both Google Home and Alexa has provided us with abilities to get the weather, make phone calls, and experience entertainment.

For people with disabilities, voice assistants have brought about new opportunities for saving time and assisting when needed.

Voice Assistants

Let's take a look at how voice assistants are changing the lives of the disabled from the actual people who use them.

“It Saves Valuable Time”

Robin Christopherson, head of digital inclusion at *AbilityNet*, makes a great case for AI for accessibility by explaining how the disabled community is benefiting the most from the escalating efforts of tech giants.

Being visually impaired himself, he found that virtual assistants such as Siri, Cortana, and Google Now already save him and other people with disabilities valuable time when getting things done.

No more battling with screen readers and “accessible web sites” for Christopherson. He adds, “What Siri can do in 5 seconds might take me 5 minutes, or sometimes 10!”⁵

⁵Voice assistants are changing how user with disabilities get things done
www.modev.com/blog/voice-assistants-are-changing-how-users-with-disabilities-get-things-done

It’s amazing to see the difference these products created for entertainment purposes can actually help everyone get things more efficiently.

Table 7-2 lists some of the features for some of the popular voice assistants.

Table 7-2. *Voice assistant features*

	Alexa	Google Home	Cortana
Vision	Large text setting for App (not for iOS)	Screen reader for Nest display	Use of Narrator
Hearing	Pair Alexa with Bluetooth	Play alert sounds (visual indicators available)	Type what you want to do—see response
Mobility	Keyboard navigation	Media controls	Keyboard navigation
Speech	Customized Wake words	Change language	Talk to text

How gamers with disabilities helped design the new Xbox Adaptive Controller’s elegantly accessible packaging Case Study

Think about the last time you had to open a package that was difficult to open. Todays electronics, including gaming systems can have challenging packaging. Twist ties that bedevil, thick plastic requiring scissors to break open, tape that gets wrapped around fingers, and those cursed strips known as zip ties; packaging can be annoying for any consumer. But for people with disabilities, it often creates yet another challenge in a world riddled with them, an unnecessary obstacle that leads to frustration and a delay getting to the object inside.

Recognizing that reality, Microsoft’s Packaging Design team faced a unique challenge in creating a box for the new Xbox Adaptive Controller, designed to accommodate gamers with limited mobility. The box for the device, which will be available for \$99.99 in September through the

Microsoft Store, needed to be as accessible as what was inside. It had to enable gamers with limited dexterity, who might be using just one hand or arm, to easily open the box and remove the controller. And it had to be as high-quality and aesthetically appealing as any other Xbox packaging.

It was the first time Microsoft had created packaging designed specifically for accessibility, and getting it right was critical.

“The product team was putting so much diligence into getting the controller right that to not have a package that was thoughtfully and mindfully designed for the end user would have felt like a real miss,” said Kevin Marshall, creative director of Microsoft’s Packaging Design Studio.

“With this product in particular, we felt a heightened responsibility. We wanted to create a package that was clearly designed with the end user in mind, and we wanted it to feel like it was just part of our ecosystem,” he said. “We wanted it to be empowering, but we didn’t want it to stand apart from any package we create.”

Solomon Romney, a Microsoft Stores retail learning specialist in Salt Lake City, Utah, was among the gamers who tested the packaging as it was being developed. The extra attention to accessibility, he said, creates a positive experience from the start.

“It’s great that we’ve created this controller for people to use, but if they can’t even get it out of the box, we’ve sort of fallen on our face with this whole process. This makes such a huge difference in how someone gets our device out of the package,” he said. “I still think about it and think, why isn’t more packaging like this?”

Mark Weiser, the Microsoft designer who created the packaging, started by looking for examples of other accessible packaging. He found little that excited him, and even the accessible products Weiser looked at weren’t often packaged in ways that made them easy to open. It benefits everybody to have a package that opens a lot faster, with less hassle.

Weiser worked closely with Xbox design researcher Scott Wang, who consulted with gamers and disability advocates as the Xbox Adaptive Controller was being developed. Their feedback helped shape many of

the device's features, including the packaging. Weiser had already decided not to use twist ties, but the gamers Wang spoke with provided other key insights, including one main stipulation—no teeth. They told Wang about using their teeth to open everything from cereal boxes to beer bottles. If nothing else, they said, the box should not require teeth to open.

The gamers also said they'd prefer more simple steps to open the box than fewer but more complicated steps. Being able to access the controller from multiple points was also important. And the gamers identified a feature that became a key part of the package's design—loops that enable users to easily open the box and remove the controller. Weiser added a loop on the outside of the specially designed retail shipping box so users could easily remove the sealing tape. Another loop opens the interior box holding the controller, which has a hinged opening rather than a lid that could require two hands to remove.

Yet another loop is integrated into the quick-start guide sitting under the controller. A user who can't reach into the space under the controller and slide it out (another accessibility feature) can use the loop to remove it. And since the controller has grippy feet to hold it in place for gamers who might play on wheelchair trays or tables, the loop on the guide eliminates the possibility of the controller sticking to the paper tray under it. An additional loop on the paper encircling the controller cables makes them easy to remove.

Other accessibility features include folding the warranty and compliance guide on the long edge to minimize the amount of arm movement required and centering the controller in the box to provide greater stability.

The designs and materials used for the other components were also carefully considered. The retail box is made of a rigid paperboard that provides additional device protection and offers less resistance than other papers when opened. The pulp tray under the controller is open at the front for easy device removal, which required extra technical and design attention. Paper is the medium of choice for Microsoft packaging, as it's

more environmentally friendly, and plastics are avoided unless absolutely necessary.

Since Weiser was creating the packaging as the controller was being developed, he needed to adapt the box as the device evolved. Even small changes to the controller required him to reevaluate how the box interacted with it—for example, ensuring that the two large buttons added to the top of the device wouldn't be clicked repeatedly if the box was jostled. The final packaging involved more than 100 iterations of its various components, Weiser said.

"It became an incredibly deep and broad scope of work," Marshall said. "That's part of the fun. That's part of our learning process. We learn by doing. We learn by building, and on this particular product, there was a lot to learn."

As he was developing the packaging, Weiser tested it with multiple Microsoft employees who have limited mobility. One of the employees, Weiser said, was doubtful he'd be able to open the box, given his usual difficulties with packaging. But to his surprise, it opened more easily than expected.

"It was really great to see him be excited about it," Weiser said.

Microsoft designers enlisted gamers with disabilities to test a variety of prototypes in order to make the packaging more accessible. The Microsoft team also tested the packaging with several gamers in the United States and the United Kingdom, including Mike Luckett, an avid gamer from Colorado who has limited mobility in his fingers from a spinal injury he sustained in a motorcycle accident. Luckett provided feedback on typical packaging pitfalls, from paper cuts caused by perforated or corrugated edges to the plastic covers some controllers come in, which he finds "incredibly frustrating" and difficult to open.

"I'm excited that Microsoft is taking the opportunity to try to understand individuals who have less ability to open a traditional package than able-bodied users," he said. "Having this easy-to-open packaging doesn't just

benefit us in the disabled community. It benefits everybody to have a package that opens a lot faster, with less hassle, so you can game faster.”

Romney was shown three prototypes of the packaging. Born without fingers on his left hand, he tested the models using that hand only. Based on Romney’s feedback, the loops on the packaging were created in an oval shape to accommodate gamers who might not be able to navigate a smaller circular loop. Romney appreciated the loops and the overall ease and elegance of the packaging.

“The whole thing sort of blossoms open in this really beautiful, fluid way,” he said. “The package just sort of opens and hands you the controller. What’s wonderful about it is the effortlessness.”

I think as a case study of inclusive design, the Xbox Adaptive Controller is going to make a brilliant example of how you do it and how you include your audience and design *with* a population, rather than *for* a population. Romney said the experience has made him think about packaging differently.

“We have customers in our store every single day who buy product. I look at our laptop boxes and how they have to be opened. How many steps, how much packaging, and how much of a barrier do each of those pieces become to someone with a mobility limitation?”

Romney thinks the Xbox Adaptive Controller packaging has the potential to set a new standard.

“I think it’s going to change how we look at things in the industry, in terms of how we make boxes. And I think it has to,” he said. “I think as a case study of inclusive design, the Xbox Adaptive Controller is going to make a brilliant example of how you do it, and how you include your audience and design *with* a population, rather than *for* a population.”

For Marshall and Weiser, the packaging project was challenging, time-consuming—and ultimately rewarding.

“It was a really powerful experience,” Marshall said. “I don’t think you realize, until you’re required to think differently, what you take for granted. As a designer, when you see things through a completely different lens, it’s paradigm-shifting.”

Said Weiser: “We put in a lot of extra time on it, but it was a pleasure to be able to work on this type of project. It’s great that we’re focused on this as a company.”

Discussions are underway about how Microsoft might use the learnings from the Xbox Adaptive Controller packaging. Marshall hopes the deceptively simple-looking box can serve as a springboard for future efforts.

“It’s certainly changing how we’re looking at packaging. We’re excited about moving forward from this point with a new lens and looking at what we can do,” he said.

“We’re really excited to take this journey on.”⁶

The Future of Assistive Technology

This is a very exciting time for new developments in assistive technology. Not only are existing AT programs regularly updated, but new and previously unseen technology is en route to improve accessibility for persons with disabilities. With the advent of e-book readers like Kindle, Sony E-reader, and recently the Nook released by Barnes and Noble, there could be another wave of new methods for people with learning disabilities and other conditions to access e-books and books. While not all of the devices have text-to-speech capability, some of them do, and if it proves useful, other producers of e-book readers will probably follow suit and adopt that utility in the near future.

⁶“How gamers with disabilities helped design the new xbox adaptive controller”
<https://news.microsoft.com/features/how-gamers-with-disabilities-helped-design-the-new-xbox-adaptive-controllers-elegantly-accessible-packaging/>

By current estimates, more than 4,000 assistive technologies have been designed for the disabled and seniors. These devices include everything from wheelchairs to a wide assortment of high-tech tools, and many companies today are turning their research and development to assistive technologies.⁷

Conclusion

There is so much to be explored and yet to be created when it comes to assistive technologies and the devices we use today. In Chapter 10, we will discuss emerging technologies related to accessibility. Having an understanding of the types of technologies associated with accessibility helps us move forward with being able to figure out the best way to build our products. In the next chapter, we will look at integrating accessibility into our design and development systems.

Every goal is possible from here. We live in a technologically advanced world that has provided us with tools and the skills to build more accessible products so that we can use them today and as our older selves when things that once worked one way have gone to a different way of working.

⁷Assistive Technologies www.disabled-world.com/assistivedevices/