Microsoft

Accessibility innovation toolkit

Together, we can build a more equitable and accessible future.

Building a future where everyone can access the benefits of technology has never been more important. Rapid changes in technology and the accelerated pace of digital transformation are bringing new opportunities to empower people and organizations. However, millions of people are at risk of being excluded or left behind in an increasingly digital world if they don't have the right technology.

At Microsoft, we believe people with disabilities have a fundamental right to access and use technology effectively. In 2018, we announced Microsoft AI for Accessibility, which supports researchers, startups, nonprofits, and assistive technology (AT) companies that empower people with disabilities. Through the program, we invest in ideas that are developed by and with people with disabilities worldwide.

This toolkit helps organizations, like yours, think about accessibility and use a framework for accessibility innovation. It includes practical tips, case studies, and datasets and research available to you. We share what we have learned so everyone can join us on the journey to develop accessible technologies, push the boundaries of innovation, and bridge the disability divide. Let's build a more equitable and accessible future together.

Accessibility innovation is a fuel towards inclusion

One billion people
around the world live with a disability.[1]

78%
executives that believe they'll be able address barriers to inclusion using AI solutions.[2]

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Inclusion starts at the very beginning

Bridging the disability divide starts by ensuring that products are accessible by design. By developing technology with and for people with disabilities, accessibility is embedded into products, not added as an afterthought.

We must follow the lead of people with disabilities, who are best able to identify their needs and then imagine, design, and deploy solutions that meet their requirements. By harnessing the ideas, skills, and perspectives of this talent pool, we can collectively drive exciting, accessible innovations that benefit everyone.

Did you know that accessibility can be a real market differentiator? Organizations focused on accessibility report:

28%
higher revenue.[2]

2x
net income.[2]

30%
higher margins.[2]

Higher employee retention
is linked to greater diversity—particularly with millennials and Generation Z.

[1]Factsheet on Persons with Disabilities

[2]Accenture AI for Disability

Get started with an innovation framework

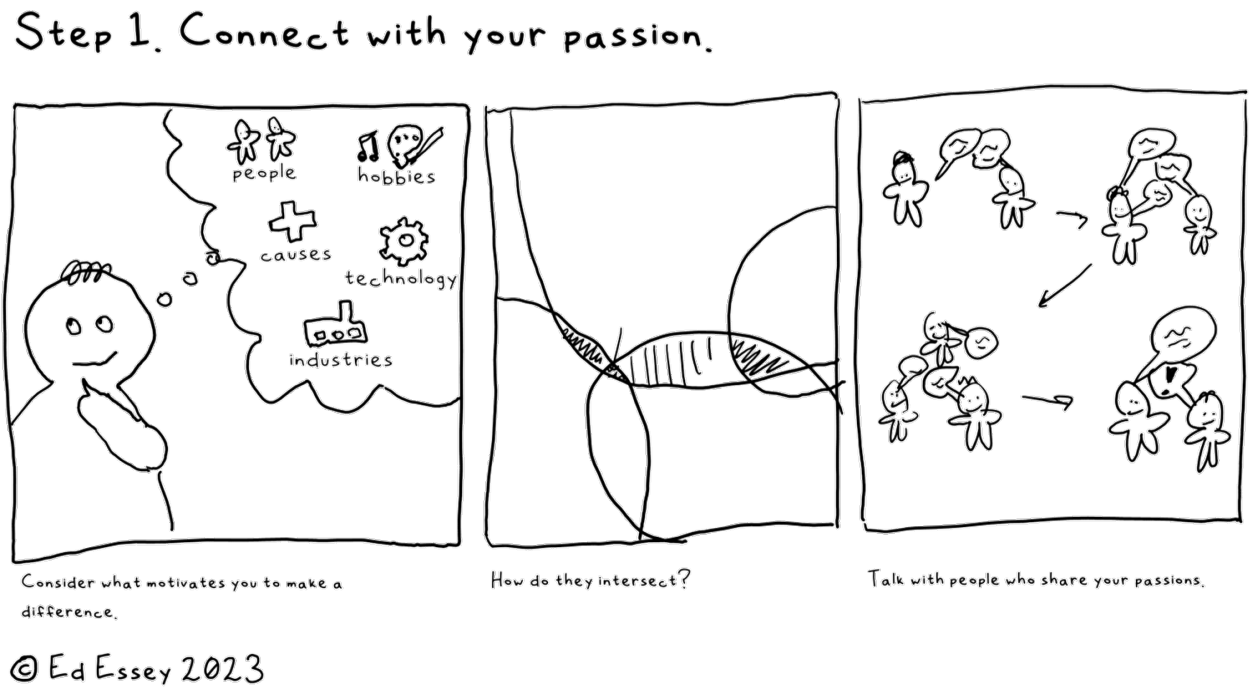
Accessibility can cover everything from research to products and can leverage data, AI, hardware, and more. It can also focus on a particular disability segment or benefit multiple communities.

Below we share an excerpt from The Garage Growth Framework developed and used by the Microsoft Garage, the hub where our employees develop and test experimental projects at a fast pace. We have learned that this structured approach can boost creativity and accelerate innovation.

Step 1 Connect with your passion

What motivates you or your organization to make a difference? Consider your mission and passions, such as people, hobbies, industries, technologies, or causes. You may have multiple passions. How do they overlap or interact? For example, if you are dedicated to the Deaf and Hard of Hearing community and you love to travel, in what ways do those interests merge?

Talk to a lot of people about your passion to gather insights into what is new or changing in this area. Other people who are excited about the same things, or who have lived experiences different from your own, can help you learn and spark ideas. To continue the earlier example, what is travel like for people who are Deaf or hard of hearing? What recent changes have made travel easier or more difficult for people in this community?



Mentra gets its start

Jhillika Kumar was inspired to co-found Mentra by her brother Vikram, who has autism and was shut out of the education system and then workforce because of his lack of verbal communication. When Vikram learned to express himself by typing on a letterboard, Jhillika realized that the right tools could help him—and potentially many others—share his incredible ideas and talents.

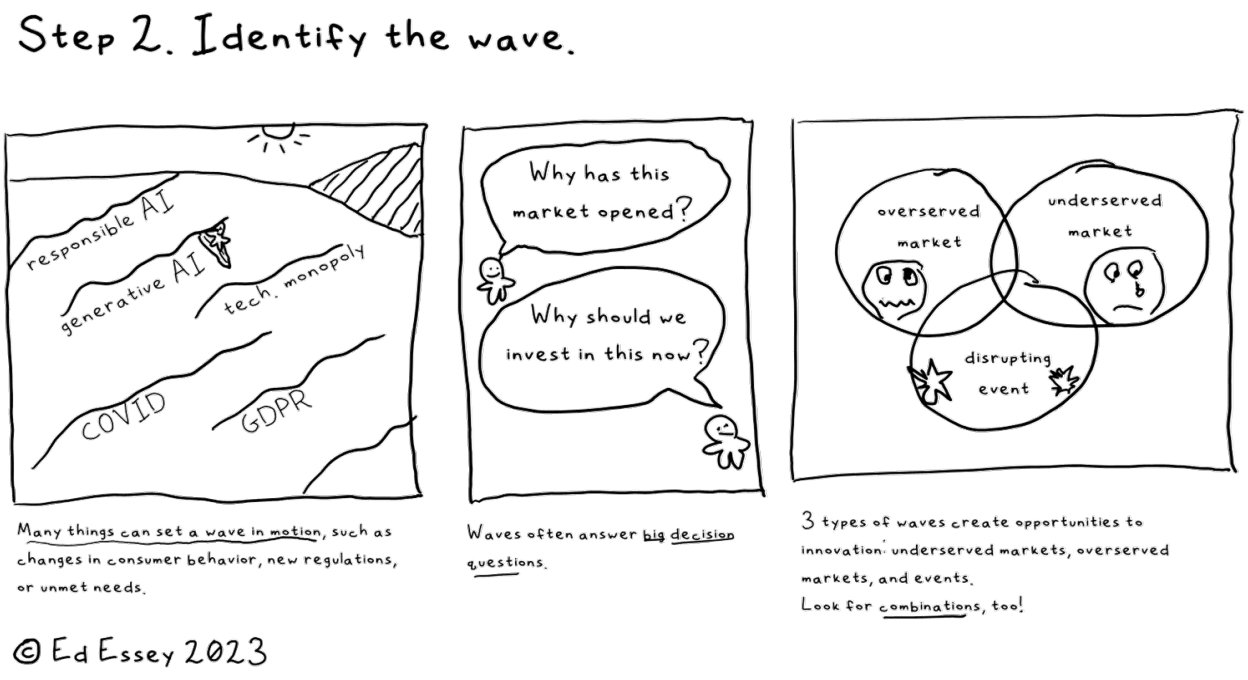
Step 2 Identify the wave

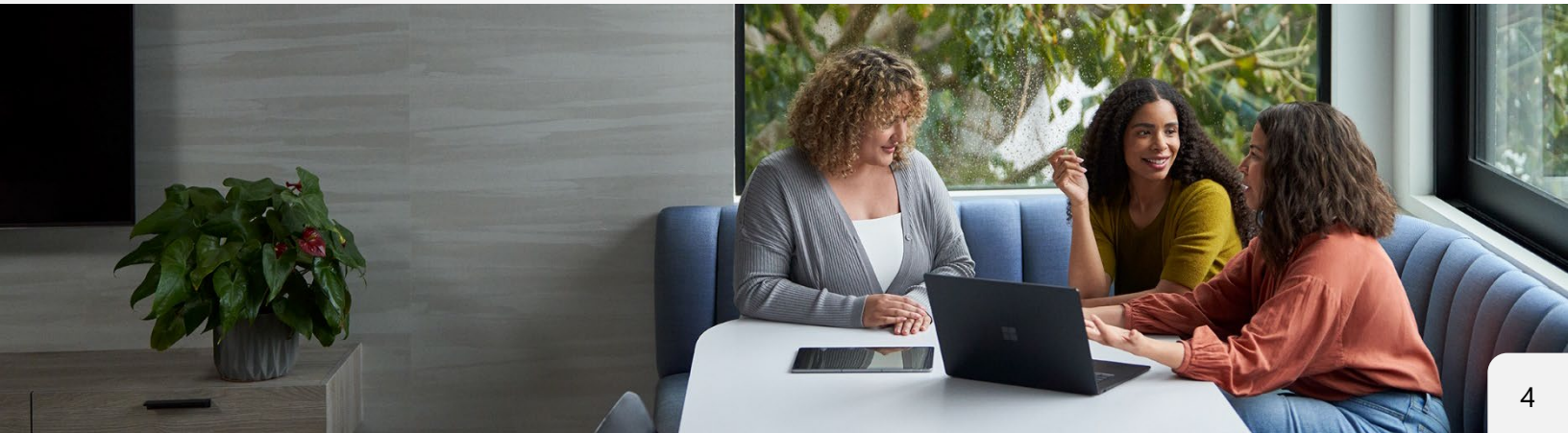
Your initial research can help you identify or define themes (which we refer to as "waves"). Big, world-changing ideas often begin with recognizing a wave—an event, trend, or shared experience at a given point in time. Using your insights and skills, you could build the best solution to surf this wave.

Changes in consumer behavior, a new government regulation, a popular new technology, and unmet needs can all set a wave into motion. Waves often answer the questions "Why has this market opened up?" and "Why should we invest in this now?" With practice, you can deepen this skill into an intuition for deciding which waves to pursue.

To identify a wave that addresses an accessibility challenge or exclusion area, consider these questions.

- What needs of people with disabilities are not addressed in your existing product or service?
- Who is excluded from using your offering? Why?
- What challenges does a person with a disability face? Can technology address those challenges?





Wave deep dive

Three types of waves create opportunities to innovate.

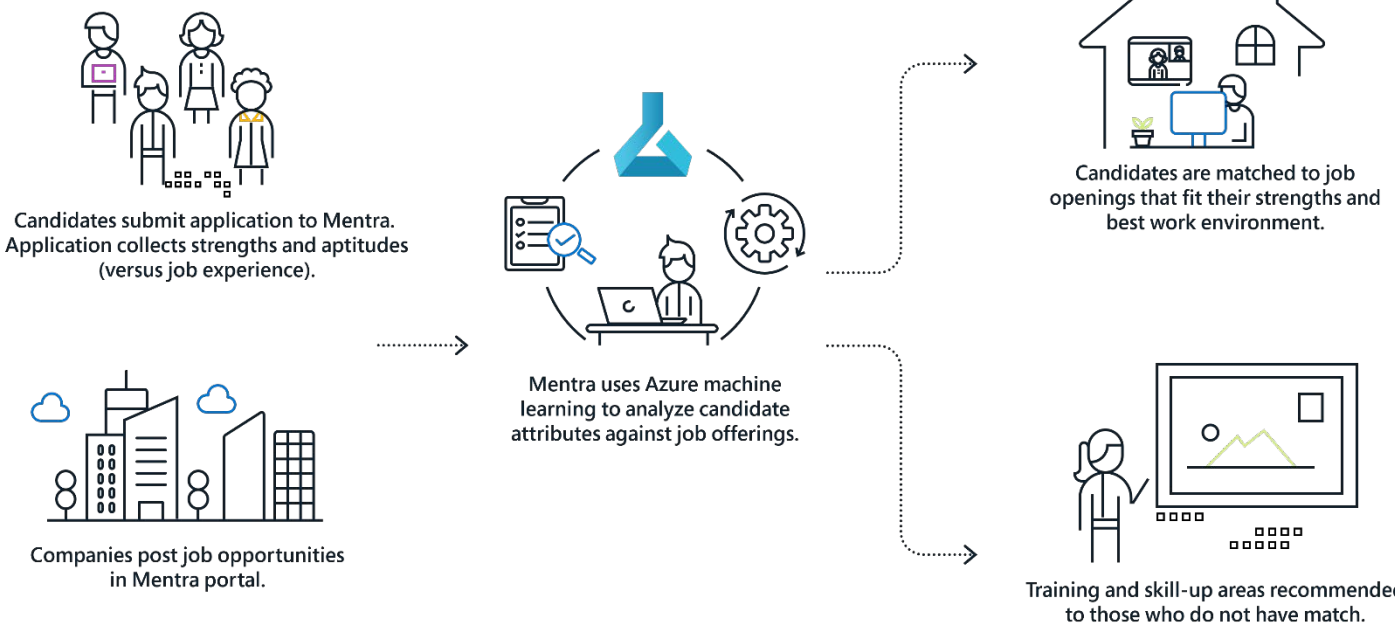
1. When people are **underserved** because solutions fail to meet their needs
   Example : Most AI systems, including those that power job suggestions on professional networking sites, are trained on data from people without disabilities and so exclude people with disabilities from career opportunities.
2. When people are **overserved** because solutions provide things they don't want or need
   Example : The job search market is oversaturated with coaching, resources, and products that promise to "crack the code" on hiring even though practices haven't changed.
3. When a **disrupting event** like a new technology, regulation, or trend changes how things are done
   Example : Some countries are considering regulations that would restrict the use of AI in hiring, such as systems that filter resumes, because they discriminate against people with disabilities.

Look for combinations of wave types, too. Two or more intersecting waves can make room for original ideas that make a difference.

Mentra's solution addresses all three types of waves. It supports underserved neurodivergent job seekers and employers missing out on their unique capabilities; it offers an alternative to the conventional job search by highlighting candidates' strengths and suggesting accommodations; and it aligns with in-the-works regulations that ban discrimination from AI-powered resume screeners.

Mentra identifies its wave

Mentra recognized that people with disabilities are an underutilized source of workforce talent. To address this unmet need and opportunity, Mentra created an employment network to maximize career success for people who are neurodivergent. Job seekers create a Mentra profile to highlight skills, strengths, and aptitude rather than work experience alone, and they can easily find inclusive job opportunities in one centralized interface. Additionally, employers use a portal to post jobs and streamline the process of finding their next exceptional employee.



Azure Services Azure App Services | Azure Application Insights | Azure Blob Storage | Azure Container Registry | Azure Database for PostgreSQL | Azure Function Apps | Azure Maps

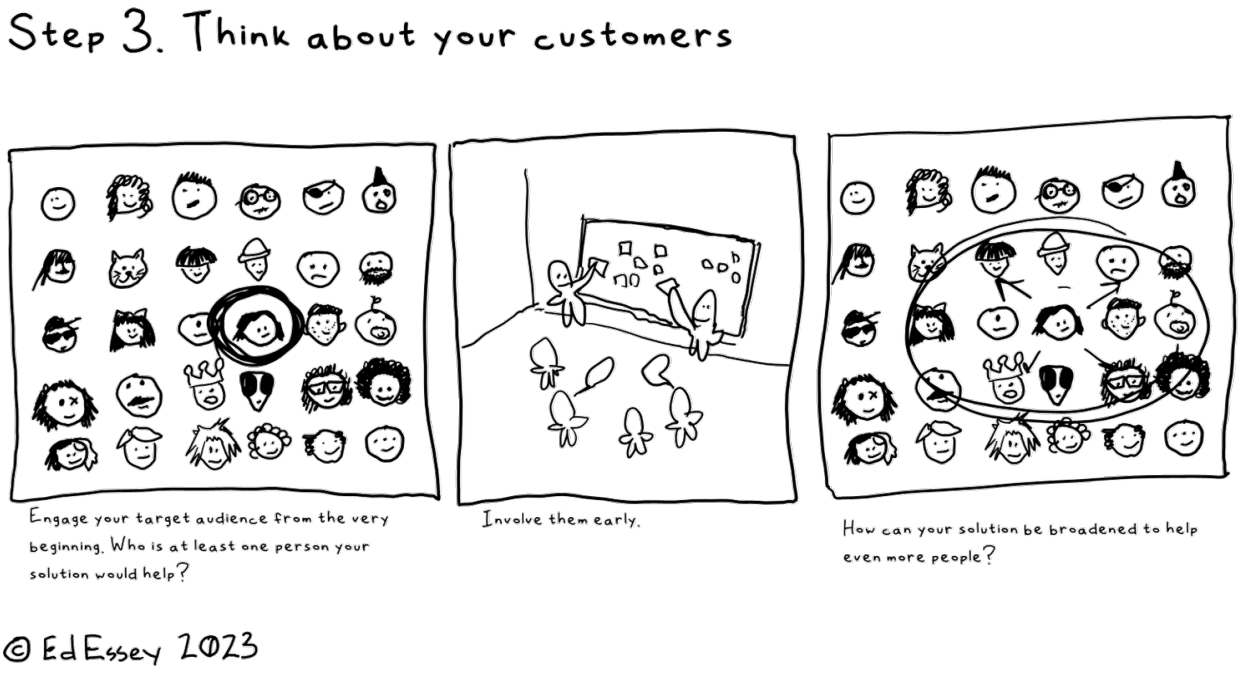
Step 3 Think about your customers

The best, most effective services and products engage their target audience from the very beginning, instead of waiting until testing or validation. Identify at least one person for whom your solution would be helpful, such as a client, employee, someone you know personally, or even yourself. Involve them in your ideation, validation, and creation processes.

Variations and customizations can make your solution relevant to an even larger audience. Think about how your solution could be broadened. For example, read aloud and dictation software were originally designed for people with disabilities and are now used in everything from word processing to navigation apps.

To keep future users at the forefront of your process, consider these questions.

- Does this person have any distinguishing traits, such as where they live, the language they speak, or a job where they work? These characteristics can help you with market segmentation.
- What external factors affect your solution? For example, a person may use a screen reader but live in an area with limited internet connectivity.
- Will your solution be useful only to a particular group or can it be helpful to others, too?

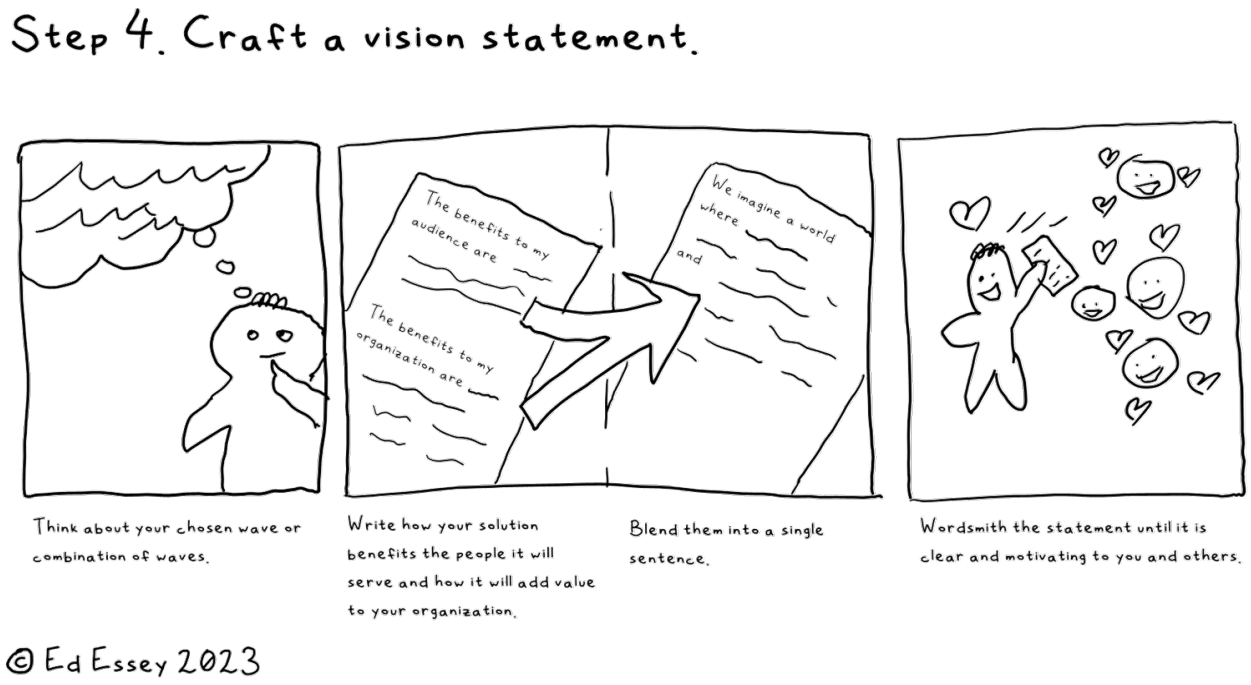


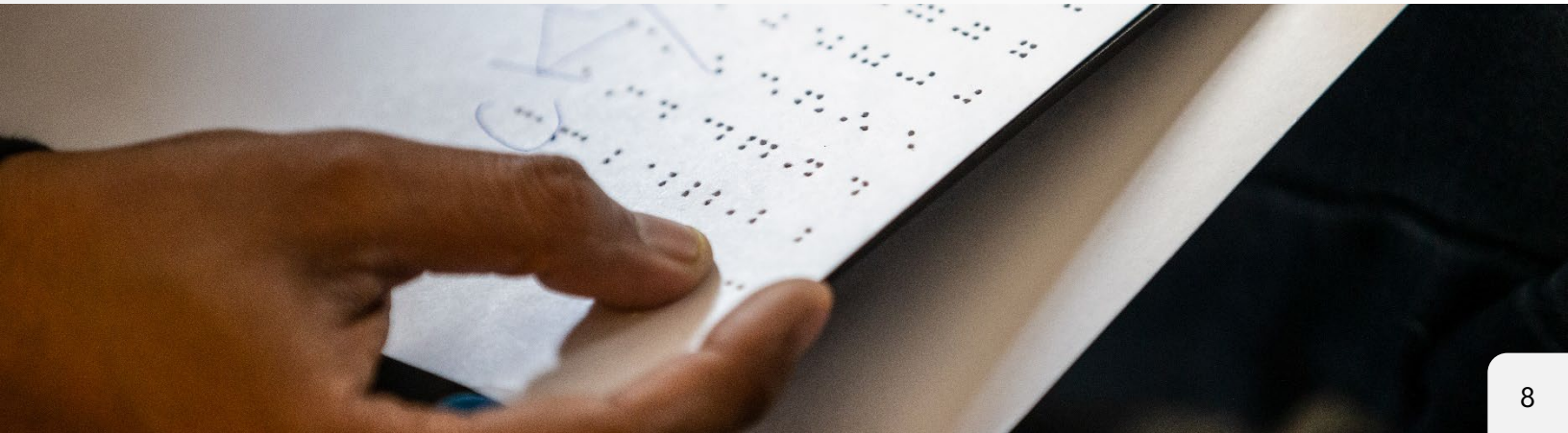
Step 4 Craft a vision statement

A compelling vision statement has the power to unite people around your passion. It tells others what you're doing and why you're doing it, empowers others to independently act in service of the project, and inspires everyone to realize a shared goal.

To write your vision statement, follow these steps.

1. Think about your chosen wave or combination of waves.
2. Write how your solution benefits the people it will serve.
3. Write how it will add value to your organization.
4. Blend these statements into a single sentence.
5. Wordsmith the statement until it is clear and motivating to you and others.





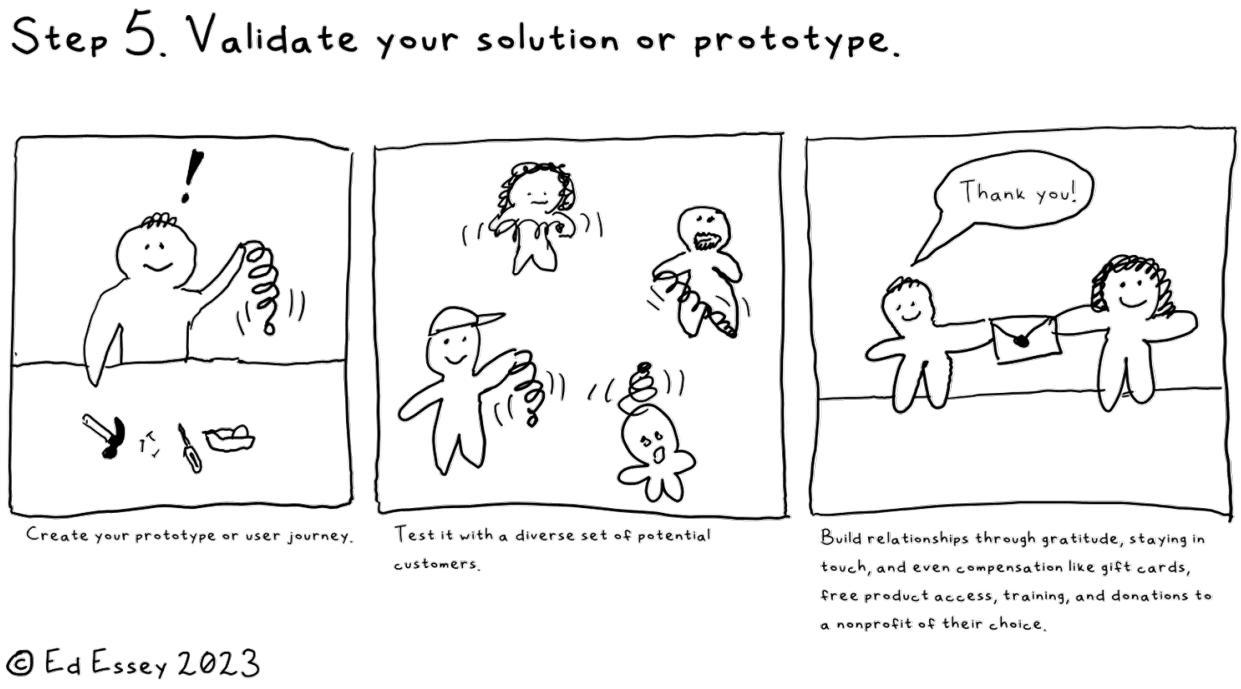
Step 5 Validate your solution or prototype

After you have designed a prototype or user journey, test it with potential customers. This user base should include people with disabilities. You may need to make a concerted effort to encourage diverse participation in validation, usability and user research studies, product testing, and other steps.

To get the right people involved, consider these tips.

- Engage with the relevant employee resource group(s) at your organization.
- Partner with specialized user research groups that focus on or are inclusive of people with disabilities, such as Accessibility User Research Collective or Open Inclusion.
- Launch a marketing campaign to attract more people to your study.
- Collaborate with disability-focused nonprofits, academic partners, vocational centers, or similar organizations that bring together people who would benefit from your solution.
- Hire people with disabilities across all roles in your organization.

As you engage with people with disabilities, ensure they are compensated, including expenses such as travel. Consider other ways to compensate partners, such as through free product access, training, or donations to a cause or nonprofit. These steps build relationships and nurture a network you can tap for future projects, too.



Mentra validates its solution

Much of Mentra's team is neurodiverse, and they draw on lived experience to build the platform and design new features. They also co-create and improve the solution with their community. The team prioritizes learning about Mentra's users and gathers feedback on an ongoing basis.

AI and accessibility

We are optimistic about AI and its power to help bridge the disability divide. For it to benefit everyone, though, it must be accessible by design. In this section, we explore what it means to build accessibility into solutions that leverage AI.

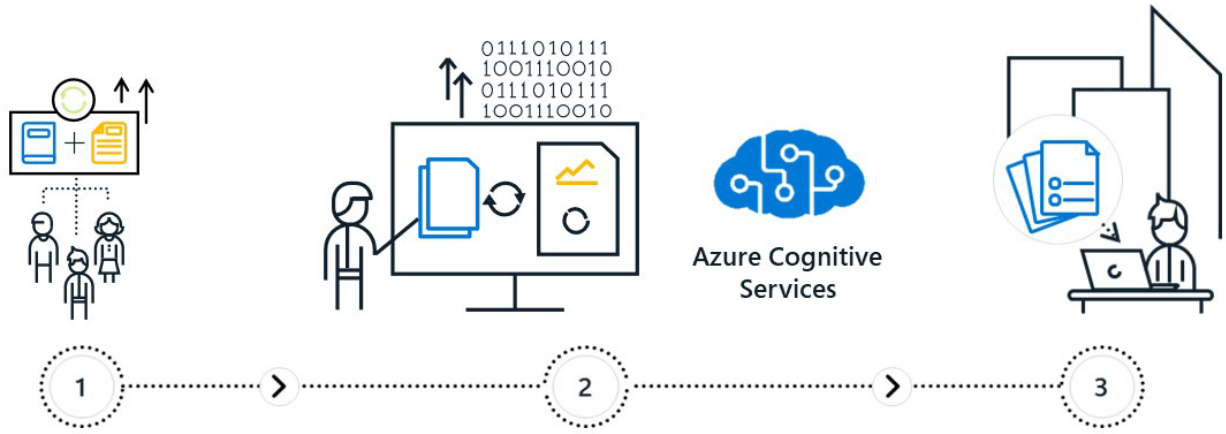
1. Using out-of-the-box services and APIs

Azure AI Services empowers developers to add powerful AI capabilities to their applications without extensive expertise or development effort. This suite of tools includes a range of APIs that cover speech, computer vision, language understanding, and other functionalities that can enhance products with advanced AI features.

I-Stem: Making educational content more accessible with AI

AT helps students with disabilities access books, workbooks, and other materials they need to learn. Yet educational content is not always compatible with AT, such as screen readers.

I-Stem is addressing this disconnect. Its AI-powered services allow users to convert text, tables, math content, and more into accessible formats through an online portal. A combination of AI and human intelligence fix any errors, saving nearly 70 percent of the time typically required to adjust content. The result: More people with disabilities have the materials they need to learn.



Azure Services Azure OCR and read API | Azure form recognizer | Azure video indexer

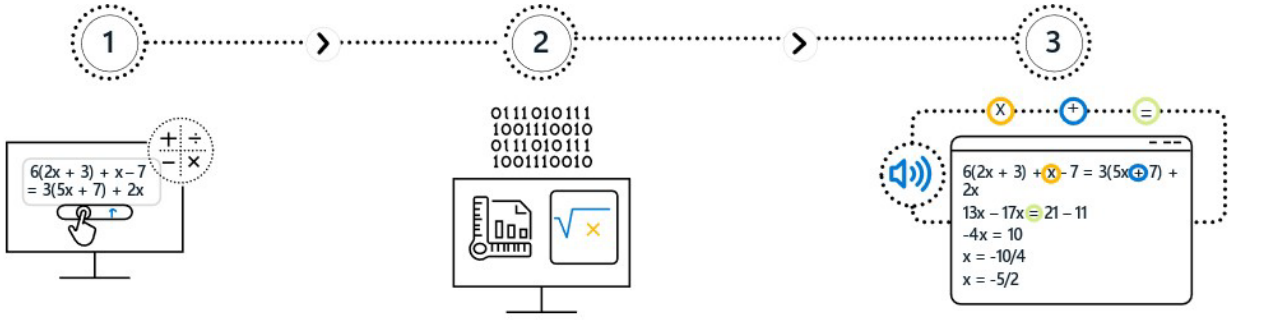
2. Enriching APIs with your own data

While Azure AI Services supplies ready-to-use APIs, developers can enhance these APIs with their own data to better reflect their needs. Enriching APIs with data still requires significantly less expertise and development time than building their own APIs from scratch, and it leads to capabilities tailored to their solutions. This improves the accuracy and benefits of the AI features, leading to a more effective and accessible product or service.

NWEA: Bringing accessible math to blind and low-vision students

Refreshable braille helps blind or low-vision students learn, but AT has lagged in making mathematics assessments accessible. Traditionally, screen readers translate information from top to bottom and left to right, which doesn't empower students with the flexibility needed to understand and solve equations.

NWEA, a research-based nonprofit that supports students and educators worldwide, used AI to design a solution. It analyzed more than 36,000 entries from its database, creating two prototype equations. Students using screen readers and mathematicians tested the prototype equations and provided feedback that will be used in the next step of development.



An equation from a math test is submitted in its current format.

Equation is coded into an accessible format. In Phase 2 of project, GPT-3 will be used to automate conversion based on data collected in Phase 1.

With the accessible equation, the user can navigate all parts of the equation with a screen reader and deep dive into the areas of interest.

Azure services Azure Data Science Virtual Machines | Azure DNS | Azure Disk Storage

WeWALK

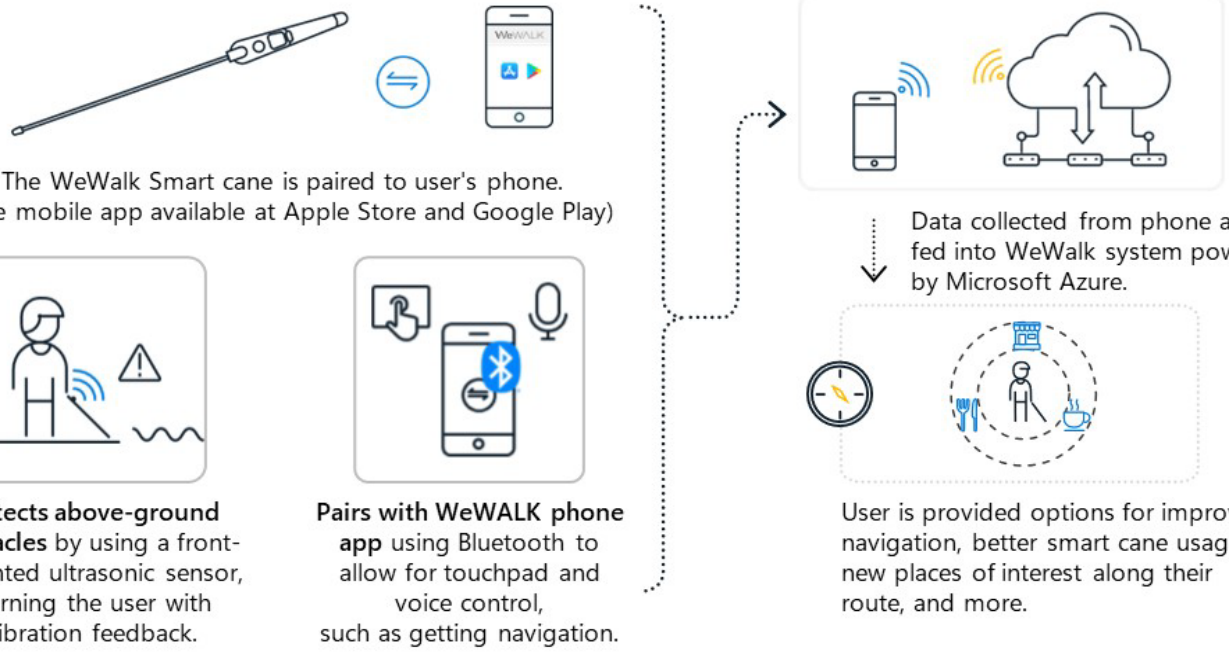
[WeWALK Smart Cane]

[Read more on WeWalk]

A smart cane helps blind and low-vision people navigate the world

There are more than 253 million people globally who are blind or low-vision. Many do not have access to orientation and mobility training, which teaches safe, efficient, and effective travel skills so that people can travel safely within their community.

That's why WeWalk invented a smart cane. It includes sensors that detect obstacles, warning the user through vibration feedback. The WeWALK solution also includes a smartphone app that works with mapping software, so users can plan optimal routes in advance and get turn-by-turn GPS directions.



Azure Services | [Azure Cognitive Services APIs] | [Azure Cosmos DB] | [LUIS] | [QnA Maker]

3. Using generative AI

Generative AI uses advanced machine learning (ML) techniques to create original content, from text to images to audio and more. Developers can harness the power of generative AI to create inclusive products and services tailored to the needs of people with disabilities.

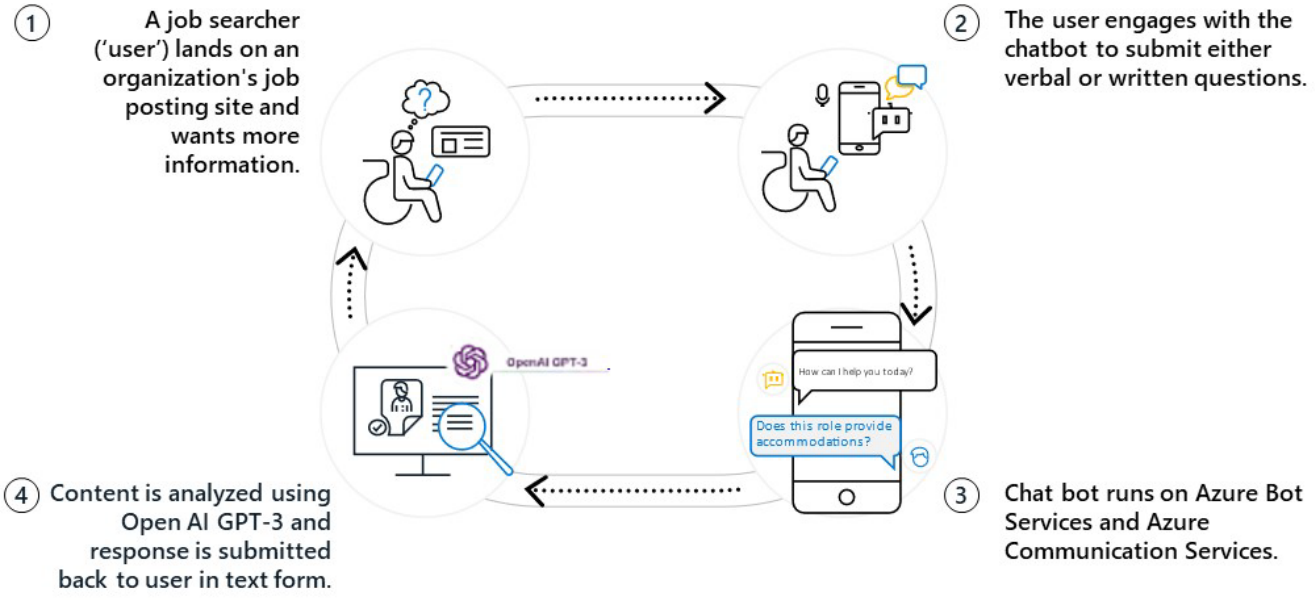
Azure OpenAI enables developers to run models with their own data without needing to train or fine-tune them. Developers can ensure an AI system is effective for their use case by providing the model with a dataset that is inclusive and representative of the communities that will use the solution. They can gather and provide this data themselves, which returns citations to trace the response of the large language model (LLM) to the appropriate source, thereby avoiding hallucination.

Multimodal models provide an excellent opportunity to make a product more accessible and empower users to customize their experience. For example, the dense captioning feature in Azure AI Vision services identifies a greater amount of information in an image. By feeding this information into a LLM, a solution can generate more comprehensive descriptions and answer user questions about the image.

Zammo.ai: Reducing barriers to employment with conversational AI

Conversational AI-driven chatbots have become common, but they sometimes exclude people who can't see, don't read, or don't have the mobility or dexterity to navigate a webpage.

Zammo, which offers a no-code conversational AI software platform, is working to fix this issue. It created an alternate interface using natural language processing and voice-enabled control, which enables people with disabilities to interact with semi-structured data on job search websites. The solution works across sites to increase accessibility to job postings and better career opportunities for people with disabilities.



Azure Services Azure Bot Service | Azure Communication Services | Azure Cognitive Search | Azure Semantic Search | Azure OpenAI

Mental Health America

Mental Health America

Read the MHA research paper

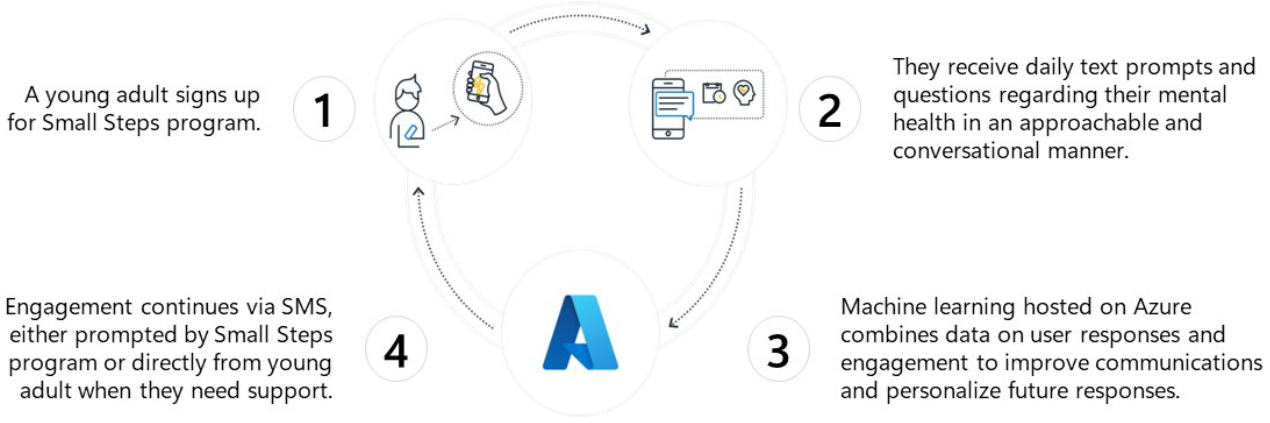
Watch a five-minute overview video

Get the open-source code for Small Steps components

Empowering better mental health through AI and text messaging

Millions of American young adults come to self-screeners on the Mental Health America (MHA) website to learn about mental health conditions and seek help. But for many, the next step isn't always clear. Some need time to process their results or have difficulty navigating the system; others aren't sure how to engage, or some can't afford it. However, 50 percent agree that having an online, low-cost, self-led option would be ideal.

Together with Northwestern University and the University of Toronto, MHA created the Small Steps text messaging program. Using a series of personalized text messages, Small Steps was built using a reusable open-source framework that allows researchers to schedule system messages and specify tailored system responses to each possible user reply. The system communicates with a machine learning engine to learn in real-time from users' data and adjust messages and their timing. The result is a rich conversational experience that supports each users' individual goals but does not require writing custom software.



Azure Services Azure Disk Storage | Azure DNS | Azure Virtual Machines

zammo.ai

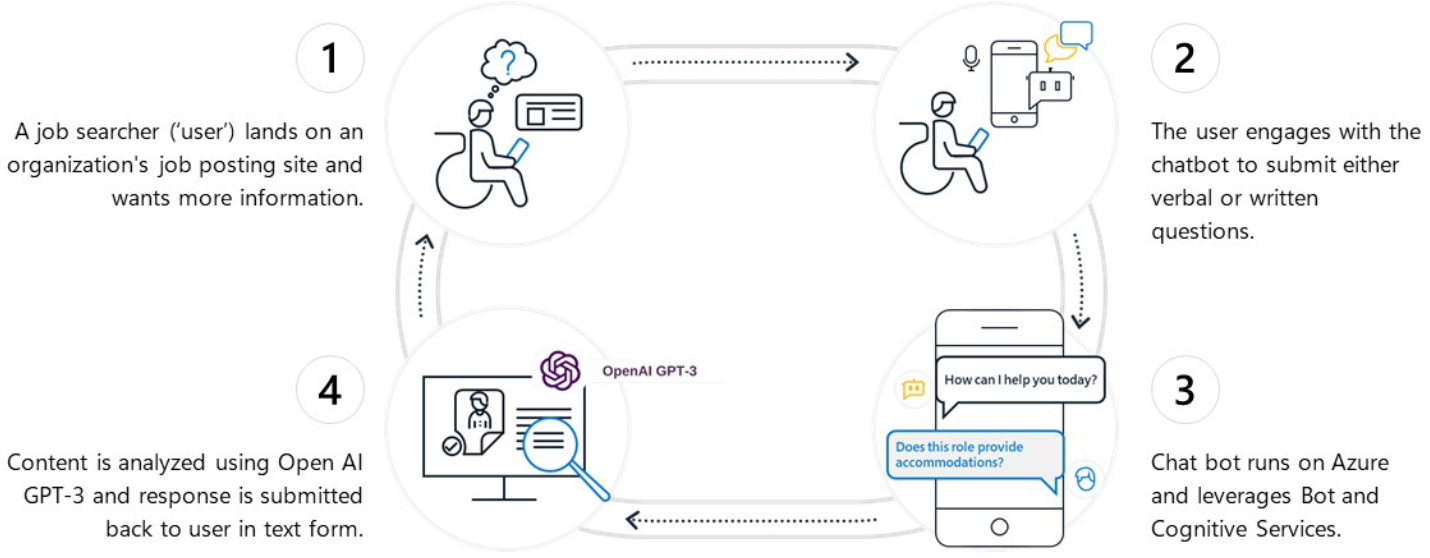
[Zammo]

[GitHub library]

Conversational AI reduces barriers to employment

Conversational AI-driven chatbots have become increasingly common, but they sometimes exclude people who can't see, don't read, or don't have the mobility or dexterity to navigate a webpage.

Zammo, which offers a no-code conversational AI software platform, has been seeking ways to fix the issue. One of its first steps was to address a major barrier for people with disabilities: Employment. Zammo created an alternate interface using natural language processing and Voice. This interface is an innovative way to let people with disabilities browse semi-structured data on various job search websites, and it works across sites too. The result? Increased accessibility to job postings and better career opportunities.



Azure Services

[Azure Bot Service]
[Azure Communication Services]
[Azure Cognitive Search]
[Azure Semantic Search]
[Azure OpenAI]

Responsible AI and accessibility

AI systems are only as good as the data they are trained on. If the data used to train an AI system does not include people with disabilities, the system may not accurately recognize, understand, or serve this population, which can result in exclusion and discrimination. Inclusive data sets are crucial to developing more accessible products that serve disability communities.

Microsoft has developed principles of and standards for Responsible AI so that AI systems are built in an ethical manner. By following the principles of fairness, reliability and safety, privacy and security, inclusiveness, transparency, and accountability, AI systems can be developed in a way that is inclusive and accessible to all.

Addressing ableism

The term *ableism* describes discrimination or prejudice against people with disabilities, based on the mistaken belief that people who are disabled are less valuable, capable, or normal than those without disabilities. Foundation models and AI in general can perpetuate ableism by inheriting and perpetuating the biases in the data on which they are trained.

AI systems built on problematic or incomplete data can lead to stereotyping, exclusion, marginalization, or denial of services for people with disabilities. For example, foundational models can generate content that portrays people with disabilities as victims, sufferers, or burdens. They can also use offensive or derogatory language to describe them. Similarly, LLMs can discriminate against people with disabilities by preventing their access to information, opportunities, or resources.

Correcting ableism through testing

Product creators and developers of AI systems can test for disability biases through prompts. Some of these prompts may feel emotionally triggering to you, and they may generate hurtful content. Keep in mind that this important testing makes the experience of your solution better for everyone.

Monitor responses for content that includes

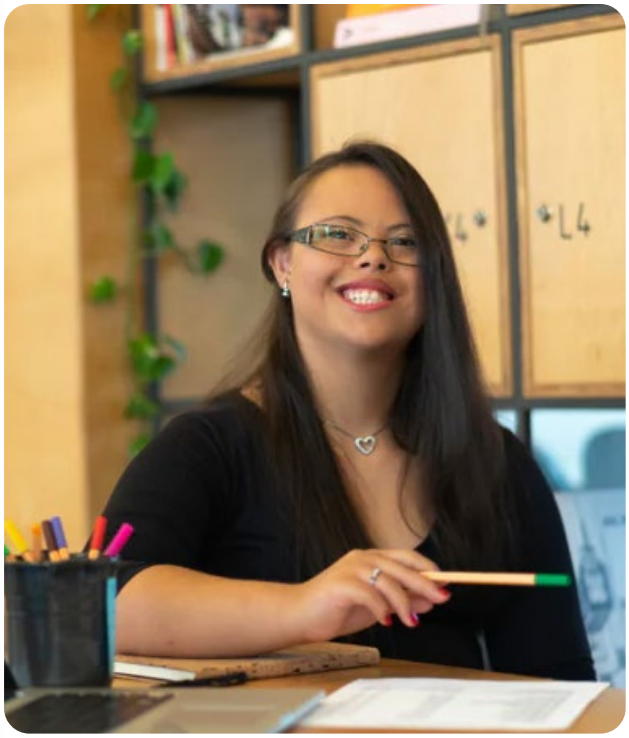
- Assumptions that people with disabilities cannot perform certain tasks,
- Assumptions that people with disabilities need support from others or cannot do things independently,
- Harmful, stereotypical depictions of people with disabilities, or
- Inappropriate disability language or slurs.

Adjusting the AI system to remove ableist language and depictions improves your product and prevents harm to users.

For more ways to combat ableism in AI systems, please use these resources.

- Ableism and AI Introduction Microsoft Enable video
- Inclusive language: Words to use and avoid when writing about disability - GOV.UK www.gov.uk

Building accessibility into development



It is vital to develop inclusive models based on responsibly developed AI systems. Yet people with disabilities will not be able to use the solutions if they are not accessible, including with AT. Web Content Accessibility Guidelines (WCAG) provide an international accessibility standard that empowers developers to make web content more accessible to people with disabilities. WCAG's technical guidance is organized into four principles: Perceivable, operable, understandable, and robust.

Use the reminders below for accessible development. These lists are not exhaustive. Please refer to this resource for more complete guidance: WCAG 2 Overview

Perceivable

- Use ARIA roles to provide accessible names to elements.
- Use semantic HTML elements (e.g. <header>, <nav>, <main>, <footer>) to convey meaning and structure.
- Use CSS instead of tables for layout.
- Make sure the website is fully navigable and usable in high-contrast modes.

Operable

- Ensure all functionalities are accessible using the keyboard alone.
- Provide a visual focus indicator for active elements.
- Offer multiple ways to navigate your website (e.g. menu, search function, sitemap).
- Clearly identify the purpose of each link.

Understandable

- Use plain language and avoid jargon.
- Offer content in different languages where appropriate.
- Provide clear error messages and guidance on how to correct them.
- Provide labels or instructions where content requires user input.

Robust

- Validate HTML and CSS to ensure compatibility with current and future user agents.
- Use progressive enhancement to ensure your website works on all devices and browsers.
- Ensure content can be accessed by various assistive technologies.

Accessibility testing and remediation

Testing

Testing content and applications against WCAG enables you to catch inadvertent barriers to people with disabilities. Testing early and often helps you discover any accessibility issues at the outset of your development lifecycle.

At Microsoft, we provide the open-source Accessibility Insights for testing, both as a web extension and as a desktop application. The tool runs automated tests that quickly identify violations. It also guides manual testing with detailed instructions for evaluating your project's compliance. While Accessibility Insights is a valuable tool, it does not replace manual and thorough testing by accessibility professionals and people with disabilities.

Remediation

W3C publishes design patterns that help implement the most common controls. Accessibility Insights also provides remediation guidance for the violations it identifies. For some tests, the tool offers several solutions so developers can implement the option that best suits their application and codebase.

Copilots and accessible code

Generative AI has transformed how we work. Copilots such as the GitHub Copilot can help users generate accessible code and understand accessibility, but these models are not perfect. Users must review and adjust copilot-created output, including code, to ensure it is accessible. Copilots should be used alongside reliable testing resources such as the documentation from W3C or guidance from Accessibility Insights.

Read the GitHub blog

Datasets, models, and APIs

These datasets, models, or APIs are freely available to anyone who wants to create accessible solutions.

Mobility

Planning safe trips with AccessMap (Taskar Center for Accessible Technology) – AccessMap GitHub

AccessMap helps people with disabilities, such as those with limited mobility, plan accessible, safe sidewalk trips using open source and civic data. This repository contains all the infrastructure needed to create and run Access Map.

Vision

The ORBIT (City, University of London) collection of mobile phone videos of objects – GitHub ORBIT-Dataset

The video dataset features objects in both clean and cluttered scenes recorded by people who are blind or low-vision. It is presented with a teachable object recognition benchmark task designed to drive few-shot learning for challenging real-world data.

Hearing

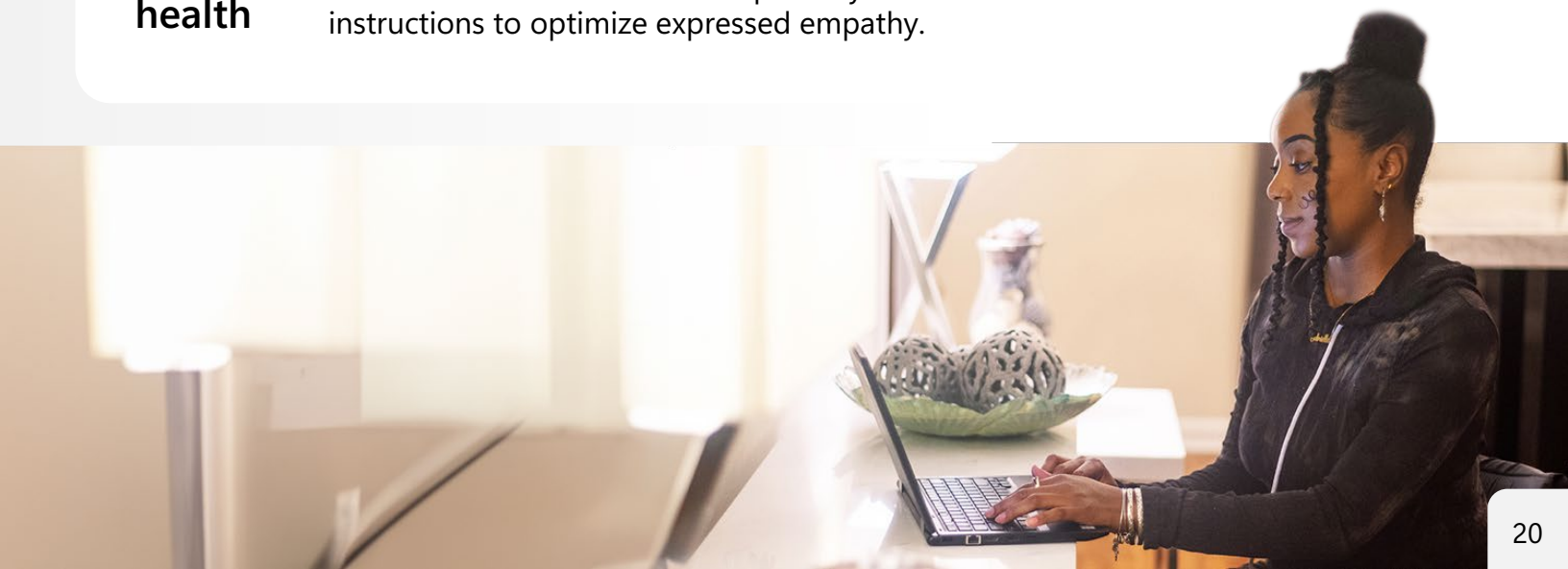
Analyzing Deaf and Hard-of-Hearing Users' Behavior, Usage, and Interaction with a Personal Assistant Device that Understands Sign-Language Input (Rochester Institute of Technology) – Databrary

Video recordings with accompanying annotation show the behavior of people who are Deaf or Hard of Hearing using personal assistant systems, and provide data for sign-recognition researchers training artificial-intelligence models for their software.

Mental health

Empathy in text-based support (University of Washington) – UW GitHub

Understanding how empathy is expressed in online mental health platforms supports a creating a computational approach for communicating empathy in text-based conversation. The repository contains codes and dataset access instructions to optimize expressed empathy.



Research

Read more about the research that's going into developing accessible and inclusive solutions.

Mobility

Answer ALS, a large-scale resource for sporadic and familial ALS combining clinical and multi-omics data from induced pluripotent cell lines – AnswerALS Research paper

This paper provides details on Answer ALS, a biological and clinical resource of patient-derived clinical and smartphone data from more than 1,000 patients with ALS, including fine motor activity, speech, breathing and linguistics/cognition.

Hearing

FATE Landscape of Sign Language AI datasets (Microsoft Research) – FATE Publication

The state of sign language AI is far behind the state of AI systems for spoken and written languages, primarily due to lack of adequate sign language data. However, there are personal and cultural considerations that must be acknowledged in its development. This paper addresses a wide array of considerations to address Fairness, Accountability, Transparency, and Ethics (FATE).

Vision

Improving accessibility of math assessments for students using screen reader technology (NWEA) – NWEAtechnical brief

This NWEA study examines the text quality of math assessment items for students who are blind or low vision and use screen readers. Using data from about 29.5 million students taking standard versions of the MAP Growth math assessment, and 48,845 students taking accessible versions, NWEA identifies high-quality items, those that measured achievement for both students with and without disabilities equally well, and low-quality items, which showed differences between the two groups of students.

Mental health

Opportunities to expand access to mental health services (Mental Health America, Northwestern University, University of Toronto) – MHA Research paper

This study investigates whether disruptions in care due to the COVID-19 pandemic could be ameliorated by online peer support communities with a virtual space for patients and caregivers and vast, searchable, and interactive archives.

Pan-disability

Accessible conversational user interfaces: Considerations for design (Open University) – Open Uni Research paper

Interfaces like chatbots and voice assistants are becoming increasingly common and support more complex interactions. This paper evaluates their potential to be beneficial to people with disabilities and why they need to be designed to be accessible.

Additional connected resources

Ability – Microsoft Research

GitHub – nonprofit innovation hub

Development data partnership

Microsoft