At Microsoft, we believe people with disabilities have a fundamental right to access and use technology effectively. Building a future where everyone can access the benefits of technology has never been more important than it is today. Rapid changes in technology and the accelerated pace of digital transformation are bringing new opportunities to empower people and organizations. However, those changes put millions of people at risk of being excluded or left behind in an increasingly digital world if they don’t have the right technology.

In 2018, we announced Microsoft AI for Accessibility, a program committed to empowering people living with disabilities. Its focus has been on harnessing the power of artificial intelligence (AI) and machine learning (ML) to improve assistive technologies and solutions with disability communities, through grants and collaboration. Through this program—and through the advancements and partnership with our AI for Accessibility grantees—we remain committed to building innovative, accessible technologies and continuing to push the boundaries of innovation to ensure we are bridging the disability divide.

This toolkit aims to help organizations, like yours, start thinking about accessibility and create a framework for accessibility innovation. It includes practical tips, along with examples, case studies, and some of the datasets and research currently available. We want to share what we have learned so everyone can join us on the journey to build a more equitable and accessible future.

### Accessibility innovation is a fuel towards inclusion

- **One billion people** around the world live with a disability.¹
- **1.3 billion people** will need assistive technology by 2050.²
- **78%** executives that believe they’ll be able address barriers to inclusion using AI solutions.³

### 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 overlooked talent pool, we can collectively develop new and accessible solutions—and drive exciting innovations that can benefit everyone.

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¹Factsheet on Persons with Disabilities  
²Global Report on Assistive Technology  
³Accenture AI for Disability
Did you know that accessibility can be a real market differentiator? Organizations focused on accessibility report:

- **28%** higher revenue.¹
- **2x** net income.²
- **30%** higher margins.³

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

Get started with an innovation framework

Accessibility innovation can cover many areas, from research to products, or data to AI. It can also focus on a particular disability segment or cover multiple different requirements. There is no shortage of opportunities or tools to use. As such, it’s important to define the scope of your project at the beginning of your journey.

**STEP 1 Identify the opportunity**

Innovation stems from unsolved needs, so the first step is to identify the challenge or an exclusion area you want to address through your product or service. Consider the following questions:

- For an existing product or service, what needs of people with disabilities are currently not addressed?
- How can your product or service be even better or remove barriers for people with disabilities?
- What are current frictions areas for people with disabilities in using your offering?
- Who is excluded from using your offering and why?
- What is a current challenge that a person with a disability has and can it be addressed through technology innovation?

**Mentra identifies the opportunity**

Mentra is an employment network that seeks to maximize career success for neurodivergent job seekers. It was created to address the fact that today’s hiring practices often unintentionally screen out the neurodiverse community, despite its unique capabilities. Its data-driven platform analyzes 76+ data points to match neurodivergent candidates with jobs that optimize for career success without relying on traditional measures of job fit.

¹ Accenture Disability Inclusion
Establish your potential customers

Next, identify at least one person for whom this technology or service can be helpful, and actively involve them in your ideation, validation, and even creation processes. This could be a client, an employee, someone you know personally—or even yourself. The best, most innovative solutions and products engage the target audience from the very beginning, instead of waiting until testing or validation.

When you solve for one, you can often extend to many. For instance, did you know that the protocols behind emails, and read aloud and dictation software were originally designed for people with disabilities? Yet we all use them daily. As a result, you might want to consider allowing variations and customizations so that the target audience can be easily broadened, and the product or service can be even more inclusive.

Questions to consider:

- Can you identify one person for whom you are solving a problem?
- What are the particular aspects of that person that can contribute to your market segmentation? For instance, do they live in a specific country, speak a particular language, or have a full-time job?
- What intersectionality elements should you consider? In other words, what external factors affect your product or service? An example of intersectionality is that the person uses a screen reader, but lives in an area with limited internet connectivity.
- Will your product be useful only to a particular group or can it be extended to anyone?

Mentra establishes potential customers

Mentra co-founder, Jhillika Kumar, created the company because her autistic brother, Vikram, was shut out of the education system and then the workforce due to his lack of verbal communication. When Vikram learned to type on a letterboard and expressed himself for the first time 27 years later, Jhillika realized that the right tools could help him share his mind’s incredible, untapped potential. If these tools could help her brother, how many other people could they help?
STEP 3 Validate your solution or prototype

After you have a prototype or user journey for your solution, it’s important to test every step with your potential customer base. This customer base should reflect and include people with disabilities. You may need to make a concerted effort to gather diverse participation to validate your idea, usability and user research studies, product testing, and more.

These tactics will vary widely depending on your project and the size and type of your organization. It can be helpful to use pilot projects to understand what works best for you. Here are some ways to get the right people involved:

- Engage with your organization’s employee resource group if one exists.
- Hire people with disabilities in your organizations and across all roles.
- Gather customer feedback through surveys, focus groups, and beta testing.
- Engage with specialized user research groups that focus or are inclusive of people with disabilities such as Accessibility User Research Collective or Open Inclusion.
- Create a marketing campaign announcing the study.
- Collaborate with disability-focused non-profits, academic partners, vocational centers, or similar organizations in your local communities.

After you’ve done your testing, make sure to ask the following:

- What does user feedback tell you about what needs to be improved, removed, or changed?
- Is the person you are building it for going to use it? Why?
- What are potential barriers for your users?
- Are there other solutions in the market that address the same need? Why is yours different?

As you partner and engage people with disabilities, make sure they are fairly compensated for their time and that you consider additional expenses they might incur, including travel, accommodation, food, and more.

Tip: Consider additional value exchange in addition to renumeration. Things like free product access, training and upskilling, fundraising, or employee donations for the cause or non-profit build strong community relationships and ensure you have a great network of people to involve in different projects.

Mentra validates its solution

Mentra’s own team is predominately neurodiverse, and it cares deeply about demonstrating the excellence an inclusive workforce can achieve. In building the platform and designing new features, the company has drawn on its lived experience and co-created solutions with its candidate base. New features and improvements are driven by feedback and investing time to learn about its users’ unique perspectives. And Mentra isn’t just a platform; it’s a community that focuses on coaching candidates through the recruitment process, upskilling, and bringing into the spotlight this diverse collective.
Real world examples

Below are some examples of organizations that are using Microsoft products and services to create new assistive technology and solutions. In addition to demonstrating viable businesses or proofs of concept, they also showcase the potential of assistive technology and what can be achieved.

Making math accessible to blind and low-vision students

The use of refreshable braille has been helpful for blind or low-vision students, but mathematics assessment is still difficult. Traditionally, screen readers parse information from top to bottom and left to right, which isn’t a very flexible approach when it comes to understanding and solving equations.

NWEA, a research-based nonprofit organization that supports students and educators worldwide, used AI to analyze more than 36,000 entries from its database, and then built two prototype equations that allowed students to navigate the equation from any angle. Equations were designed and tested by screen reader users and mathematicians while students tested them and provided feedback for next steps and furthering accessibility innovation.

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

2. 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.

3. 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
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.

1. A young adult signs up for Small Steps program.
2. They receive daily text prompts and questions regarding their mental health in an approachable and conversational manner.
4. Engagement continues via SMS, either prompted by Small Steps program or directly from young adult when they need support.

AZURE SERVICES
- Azure Disk Storage
- Azure DNS
- Azure Virtual Machines
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.

1. A job searcher (‘user’) lands on an organization’s job posting site and wants more information.
2. The user engages with the chatbot to submit either verbal or written questions.
4. Content is analyzed using Open AI GPT-3 and response is submitted back to user in text form.

AZURE SERVICES

- Azure Bot Service
- Azure Communication Services
- Azure Cognitive Search
- Azure Semantic Search
- Azure OpenAI
Addressing bias in recruiting

Employment company Mentra helps to maximize career success for neurodivergent job seekers by redesigning the job finding experience so it’s accessible to those with brains who function differently from what is considered typical. Candidates submit one comprehensive application, where Mentra’s data-driven platform analyzes 76+ data points to match neurodivergent candidates with jobs that optimize for career success.

The Mentra profile highlights skills, strengths, and aptitude rather than work experience alone, and Mentra’s dashboard aggregates inclusive opportunities in one centralized interface. Additionally, employers get their own portal to post jobs and streamline the process of engaging with the neurodivergent talent pool.

Candidates submit application to Mentra. Application collects strengths and aptitudes (versus job experience).

Companies post job opportunities in Mentra portal.

Mentra uses Azure machine learning to analyze candidate attributes against job offerings.

Candidates are matched to job openings that fit their strengths and best work environment.

Training and skill-up areas recommended to those who do not have match.
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.

The WeWalk Smart cane is paired to user’s phone.
(Free mobile app available at Apple Store and Google Play)

Detests above-ground obstacles by using a front-mounted ultrasonic sensor, warning the user with vibration feedback.

Pairs with WeWALK phone app using Bluetooth to allow for touchpad and voice control, such as getting navigation.

User is provided options for improved navigation, better smart cane usage, new places of interest along their route, and more.

AZURE SERVICES

Azure Cognitive Services APIs | Azure Cosmos DB | LUIS | QnA Maker
Educational content is more accessible with AI

Assistive technologies have come a long way in helping students with disabilities access educational content: books, workbooks, and the materials students use in and outside of the classroom to study. However, there’s still a gap that needs to be addressed, simply because this educational content is not always compatible with technology solutions, such as screen readers.

That’s where I-Stem helps. Its AI-powered services enable people with disabilities to convert content into accessible formats through an online portal, including not just text, but also tables, math content, and more. Then, a combination of AI and human intelligence work together to fix any errors, saving nearly 70% of the time generally required for content remediation.

1. User or organization submits inaccessible textbooks and documents through the I-Stem remediation portal.
2. AI-powered portal converts materials into accessible format. Enhanced with OCR (Optical Character Recognition), content is converted more accurately and faster than before. Additional manual interventions are included where needed.
3. The document or textbook is returned in an accessible format to the user or organization and can be used with a screen reader.

AZURE SERVICES
- Azure OCR and API
- Azure Form Recognizer
- Azure Video Indexer
Datasets, models, and APIs

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

**MOBILITY**

**Free access to comprehensive clinical, genetic, molecular & biochemical assessment of amyotrophic lateral sclerosis (Answer ALS)** – [ALS Data Portal](#)

The Answer ALS data portal is designed to help mine a wealth of data and resources in order to advance the development of effective therapeutics for ALS.

**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 AccessMap.

**VISION**

**Building machines that can replicate human vision, such as recognizing and describing objects/scenes** – [VizWiz Dataset](#)

VizWiz provides datasets and challenges from those who are blind to encourage the larger community to collaborate on developing algorithms for assistive technologies.

**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.

**Research data to address Resource Scarcity across sign language** – [OpenHands’s documentation](#)

An open-source toolkit makes sign language recognition more accessible to everyone, and includes sign recognition models for isolating signs and finger spelling across seven different sign languages.

**MENTAL HEALTH**

**Multi-Armed Bandit/Reinforcement learning engine for Adaptive Experiments (University of Toronto)** – [MHA GitHub](#)

An open-source, cross-platform infrastructure supports the deployment, analysis, and modification of both traditional and adaptive experiments to improve and personalize mental health-related interventions. The repository contains code and instructions on how to deploy multi-armed bandit/reinforcement learning algorithms to help determine whether interventions are helpful for a specific participant.

**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.

**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.

**AccessMap (Taskar Center for Accessible Technology)** – [AccessMap Research article](#)

This case study demonstrates how to collect and operationalize open data using a platform and community organizing to help pedestrians navigate the world.

**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).

**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)** – [RIT Research paper](#)

Voice-based personal assistant technologies continue to proliferate, leading to new accessibility barriers for many Deaf and Hard-of-Hearing users. Progress in sign-language recognition on personal devices can mitigate these barriers, but more research is needed on how users would interact with these devices.

**Addressing Resource Scarcity across Sign Language (AI4Bharat)** – [AI4Bharat Research paper](#)

There are more than 300 sign languages in the world, many of which have limited or no labelled sign-to-text datasets. Self-supervised AI training and multilingual finetuning are effective in natural language. This paper applies those ideas to sign language recognition.
Improving accessibility of math assessments for students using screen reader technology (NWEA) – NWEA technical 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.

Human-AI Collaboration Enables More Empathic Conversations in Text-based Peer-to-Peer Mental Health Support (University of Washington) – UW Research paper

This paper demonstrates how HAILEY, an AI-in-the-loop agent that provides just-in-time feedback via text message helps peer supporters improve conversational empathy and demonstrate how human-AI collaboration can empower humans in open-ended, social, creative tasks.

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.

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