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Research Statement

People with disabilities have long relied on support from others to navigate accessibility barriers—from finding wheelchair-accessible routes to accessing visual information in documents, videos, and physical spaces. While technologies—from the Internet to mobile devices and now AI—have transformed many aspects of accessibility, their future potential remains contingent on whether people with disabilities can effectively use them. Without careful design, these technologies risk creating new forms of exclusion rather than inclusion.

My research centers around accessibility and assistive technologies. I seek to enhance how people understand and navigate digital information and physical spaces to advance societal inclusion. I investigate the perceptual and cognitive factors that shape human interaction with digitally enhanced environments. And using the accrued insights, I create and improve technologies that enable people with disabilities to live more independently.

As a Human-Computer Interaction (HCI) researcher, I address the issues through a human-centered approach. I attempt to understand existing challenges around accessibility and explore research opportunities through formative studies. Combining and extending computational techniques (*e.g.,* machine learning) and emerging devices (*e.g.,* location sensors, augmented reality gears) allows me to build novel interactive technologies. I evaluate what I create through qualitative and quantitative methods that involve real users.

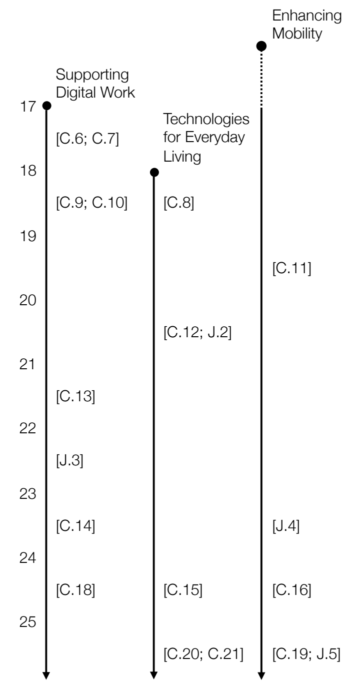

Figure 1. Timeline of my scholarship, showing publication years of my conference and journal papers. My research on mobility accessibility began in 2012 during my PhD studies and continues to this day. Since joining SMU in 2017, I have expanded my focus to include investigating the accessibility of digital work and designing assistive technologies for daily living.

My contribution to accessibility research began during my PhD, when I studied methods for collecting street-level accessibility data to inform city-scale accessibility. This work aimed to support disabled individuals in learning about and navigating the built environment to foster their independence. While I continue to pursue this research thread, my focus has expanded since joining SMU. My work now encompasses three research threads that advance the knowledge of the research field:

(i) **Supporting Digital Work.** I study the accessibility of digital work platforms and tools, and design high-value collaborative opportunities for disabled people.

(ii) **Technologies for Everyday Living.** I develop novel interfaces and interaction techniques—from hand guidance systems to interaction methods for tactile displays—that make everyday tasks like shopping and learning more accessible for independent living.

(iii) **Enhancing Mobility.** Building on my PhD work, I design, develop, and evaluate technologies that help people with disabilities navigate the built environment.

Figure 1 illustrates the overview of the evolution of my research program, and I introduce each research thread in more detail below. Please see my CV for the publication list.

For these research threads, I have been fortunate to be awarded external funding, including two MOE Tier-2 grants totaling $1,212,068—one as Principal Investigator (PI) and one as Co-PI. The quality and impact of my work have been recognized through two Best Paper Awards and five Best Paper Nominations at premier HCI venues. I note that my work is an effort with my students and collaborators. I have mentored two PhD students and partnered with university researchers and industry collaborators. Though I have made significant intellectual contributions to each work I mention in this document, I acknowledge that every achievement emerged from the work with them.

Supporting Digital Work

Software accessibility determines who can participate in the modern work environment. I study software accessibility barriers through data analysis and formative research and create solutions to address the challenges. My research enables a more inclusive digital economy by identifying accessibility barriers to work and developing solutions that create high-value work opportunities through cross-ability collaboration.

Understanding Barriers in Digital Work

Through manual and automated evaluations of 120 task interfaces on Amazon Mechanical Turk (AMT)—then the largest online gig work platform—I found that most tasks were inaccessible to workers with visual impairments due to poor interface design [C.6]. I conducted multiple sessions of interviews with and observation of three people with autism spectrum disorder (ASD), which revealed that ambiguous instructions and tasks requiring complex executive functioning (*e.g.,* planning how to perform multi-step work) created additional barriers to participation [C.7].

Beyond interface accessibility, log data analysis from 2,676 AMT workers performing 3.8 million tasks revealed a median hourly wage of $2 [C.9; J.3]. Follow-up surveys showed that workers with disabilities earned 10.8% less than their non-disabled peers [P.6], indicating that accessibility barriers extend beyond technical issues to economic exploitation. These findings demonstrate the need for both accessible interface design and systems that enable disabled workers to participate in high-value work (Figure 2).

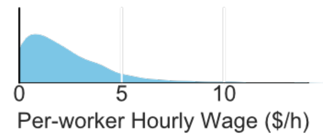

Figure 2. Hourly wage distribution for crowd work. An average worker earn about $2/h on Amazon Mechanical Turk.

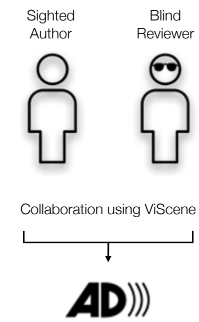

Figure 3. In the ViScene project, we developed a suite of tools to facilitate collaboration between sighted and blind individuals in co-authoring audio descriptions.

Building Tools for Inclusive Work

To explore ways to address inaccessible digital work and undercompensation, I develop solutions to make digital work platforms more accessible, then evaluate them through user studies. An example is the ViScene project, which investigated the feasibility of creating new high-value work opportunities through cross-ability collaboration [C.13; C.14; C.18]. We made a system called ViScene, which enabled blind persons to work as reviewers to assess audio descriptions authored by sighted novice describers (Figure 3). Where traditional audio description services cost $15-60 per video minute, our study demonstrated that ViScene's collaborative model reduced audio description production costs by 54-96% while maintaining quality through blind reviewers' domain expertise. This suggests that it is possible to create well-compensated, specialized roles for blind workers in cross-ability teams while making video accessibility economically viable for content creators.

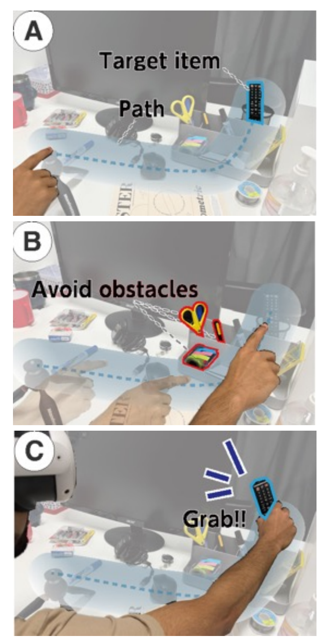

Figure 4. We develop auditory guidance techniques that help blind and low-vision individuals navigate their hands through 3D space.

Technologies for Everyday Living

Many everyday actions, such as object manipulation, reading, and writing, could become inaccessible for disabled individuals. I develop interaction techniques that make these daily activities accessible by combining emerging technologies.

Hand Guidance with Sonification

Tasks requiring precise hand movements, such as operating ATMs, using vending machines, and retrieving items from shelves, pose significant challenges for blind individuals. These activities demand locating targets, planning hand trajectories, and guiding movements for accurate reaching, all of which typically require sight. My research addresses this challenge by providing real-time feedback during hand movement to support blind people [P.17]. I developed two auditory hand guidance techniques for 3D navigation:

VERBAL, which delivers rapid spoken directional commands, and Follow-Your-Finger (FYF), which uses the index finger as an embodied reference point to generate continuous sound feedback (Figure 4). A study with 12 blind and low-vision participants revealed complementary advantages—VERBAL enabled faster movements for rough positioning, while FYF provided superior precision for final target acquisition. These findings suggest that combining both techniques could effectively support the full range of hand guidance needs, from obstacle avoidance to precise object manipulation.

Tactile Display Interaction Technique

My research explores ways to support visually impaired students' learning by designing novel interaction methods for refreshable tactile displays. For example, I developed Tactile Data Comics, which transforms complex visual information into accessible educational content by combining step-by-step tactile graphics with synchronized verbal narration [C.21]. Unlike static diagrams, this approach guides users through information progressively (Figure 5). A study with 16 visually impaired students showed significant improvements in comprehension and engagement compared to verbal-only descriptions or traditional static tactile graphics.

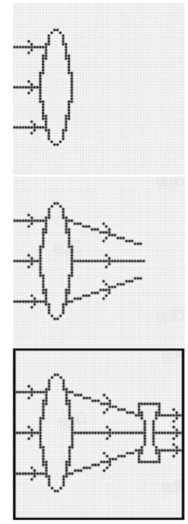

Figure 5. A step-by-step tactile data comic presentation demonstrating how light passes through a lens.

Voice-Based Text Authoring

Traditional text input through keyboards creates significant barriers for people with limited dexterity, affecting everyday writing and specialized tasks like programming. I developed voice-based alternatives that enable hands-free content creation across multiple domains [C.8; C.12; J.2]. VocalIDE exemplifies this approach by making programming accessible to people with upper-body motor impairments [C.8]. Through a Wizard-of-Oz study, we identified how developers naturally verbalize programming tasks. This led to novel interaction techniques like Context Color Editing for code navigation and manipulation through vocal commands (Figure 6). A study with eight participants with upper-limb motor impairments demonstrated significant improvements in their ability to perform essential programming tasks such as navigational edits and text selection. VocalIDE opens software development careers to people previously excluded from this field by removing keyboard dependency.

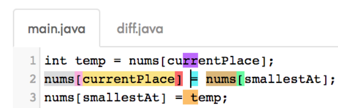

Figure 6. VocalIDE highlights sections of code that can be selected by verbally specifying a color (e.g., "orange"), enabling faster code navigation for people who cannot use a mouse or keyboard.

Enhancing Mobility

Navigating the built environment remains one of the most fundamental challenges for people with visual and mobility impairments. I have worked on building methods to collect data to inform the accessibility of the built environment and created novel guidance systems that provide real-time navigation support.

Accessibility Data at Scale

Creating effective navigation aids requires comprehensive data about the built environment's accessibility, yet traditional physical audits are expensive and time-consuming. Project Sidewalk transformed accessibility auditing from an on-site activity to a scalable online process [C.11]. The platform enables online workers and volunteers to virtually walk through city streets using Google Street View and label accessibility problems, making it possible to audit entire cities remotely. By incorporating game design principles—interactive onboarding, mission-based tasks, and progress dashboards—the system effectively trains and sustains paid workers and volunteers. An 18-month deployment in

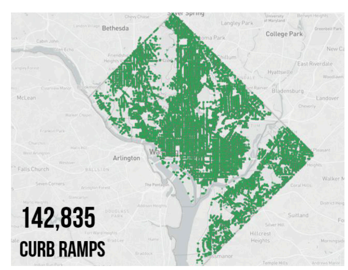

Figure 7. Project Sidewalk. In an 18-month deployment study, we collected 205,385 sidewalk accessibility labels. The map above shows the collected location labels for 142,835 curb ramps that are geo-tagged.

Washington, DC, demonstrated the platform's potential, with 797 users contributing 205,385 labels covering 2,941 miles of streets (Figure 7).

Collective Landmark Mapper extends accessibility mapping to indoor environments through a *map-as-a-by-product* approach [J.5]. Rather than requiring dedicated mapping efforts, the system automatically extracts landmark information from users' routine activities by analyzing IMU data and text notes captured during tasks like building inspections. Mathematical optimization techniques then determine precise landmark positions from these incidental observations. This approach generates comprehensive semantic maps without additional user burden, addressing the critical lack of indoor accessibility data while respecting users' time and effort.


Figure 8. We equip a robot with sensors and a harness to transform it into a robotic guide dog.

Active Guidance Systems

To support the mobility of individuals with disabilities, geographical data about the built environment's accessibility must be communicated in a format that effectively guides users. My recent work developed a robotic system, RDog, that provides moment-to-moment navigation support [C.16]. RDog uses a quadruped robot dog as an intelligent guide for blind and visually impaired individuals (Figure 8). Unlike manual tools like a white cane, RDog combines advanced mapping with active guidance through force feedback and preemptive voice alerts. A user study showed that blind participants using RDog navigated faster and more smoothly than with white canes, experiencing fewer collisions and reduced cognitive load.

RunSight represents another manifestation of a guidance system that addresses a different yet equally important challenge: enabling low-vision individuals to run at night [C.19]. The system uses augmented reality through see-through head-mounted displays to enhance runners' visual awareness by highlighting their guide's position and potential hazards (Figure 9). A study with eight low-vision runners demonstrated that all participants could run at least 1km using RunSight, while none could engage in guided running without it in dark conditions. This work shows how augmented reality (AR) can enable activities previously impossible for people with visual impairments.

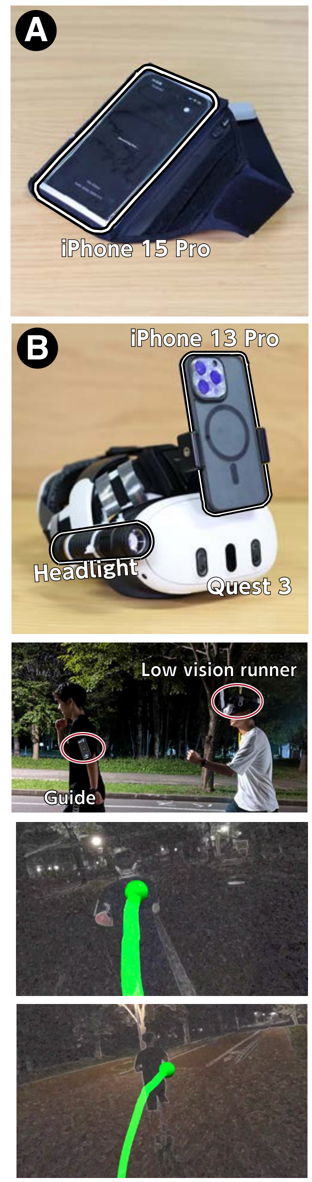

Figure 9. The RunSight system consists of (a) an iPhone worn by the guide and (b) an AR headset worn by the runner. AR-based visualization displays the guide's position, enabling runners with low vision to run safely at night.

Continuing Research

Going forward, I will continue working on accessibility and assistive technology research. I will expand the breadth and depth of my research agenda by building on my past work, such as the work that aimed to help people with dementia and their caregivers [P.15; P.16].

As a technology expert, I will continue to work with users, practitioners, and researchers across all accessibility-related domains. To create real-world impact, I will expand collaborations with social science experts to design socio-economic solutions for accessibility challenges, entrepreneurial experts to disseminate technologies, and healthcare professionals to create multidisciplinary solutions that better serve users.

Research on assistive technologies offers a lens for envisioning future innovations—today's assistive technologies often become tomorrow's mainstream tools. To push technological boundaries, I place accessibility at the center of my work, integrating computational techniques, emerging sensors (*e.g.,* ultra-wideband sensors), and novel actuation and display technologies (*e.g.,* mobile robots) to develop sophisticated assistive solutions. I believe these technologies not only address accessibility challenges but also benefit all users.

Teaching Statement

I teach two courses: Interaction Design and Prototyping (IS211), an undergraduate-level course, and Computational Interaction (CS702), a graduate-level course. My experience as a Human-Computer Interaction (HCI) researcher shapes both what and how I teach.

- **Focus energy on what matters.** Problems that are challenging yet exciting and engaging to solve drive us to think, learn, and commit. My job as an instructor is to help students find and direct their energy toward solving problems that they believe are important.
- **Solve through iterations.** Tinkering with physical and digital artifacts allows one to turn ideas into concrete artifacts and iteratively design solutions. The iterative process offers opportunities for students to fail fast, often, and softly—a process that allows us to learn from mistakes and ultimately achieve success. In the classroom, I strive to cultivate a culture that embraces failure.
- **Communication is the key.** Work needs to be communicated effectively to make an impact. As an instructor, I work with my students to teach them how to write, speak, and demonstrate artifacts to share with the world effectively.

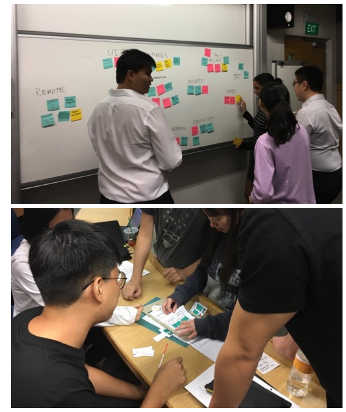

Figure 10. In IS211 Interaction Design and Prototyping, students brainstorm UI/UX ideas, then prototype and evaluate them using paper prototyping and the "Wizard of Oz" technique.

In IS211, I teach techniques to identify problems, methods to iteratively learn and address issues, and ways to effectively communicate ideas with others. The practice aligns with a user-centered design approach design experts employ to create technological solutions to problems. The course structure encourages students to learn by applying the concepts they learned in class to their projects. I have been improving IS211's course material and teaching style; I have written concise lecture notes from the ground up to complement project-based learning (Figure 10; see more on: https://smuhci.notion.site/is211-idp).

I developed CS702 from scratch. To target students pursuing master's or PhD degrees in computing, I have compiled technical aspects of HCI. Now, in the course, I teach topics like user modeling and how HCI relates to other computer science and engineering domains, such as mathematical optimization, machine learning, and control theory. I provide ample example code and hands-on activities to get students' hands dirty. I designed team assignments and projects to encourage their independent learning (Figure 11). See: https://smuhci.notion.site/cs702-ci.

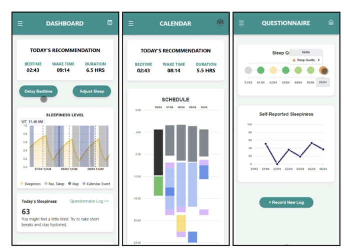

Figure 11. CS702 Computational Interaction term project by a student group. In the course, students apply computational methods such as mathematical optimization learned throughout the term to replicate advanced interactive artifact projects from published papers.

My instructor and course ratings have ranged from 5.06 to 6.69 and 4.63 to 6.62, respectively (Table 1). With the exception of the period when classes were taught online due to COVID-19 measures, which disrupted course delivery, my evaluations have consistently been good to excellent and have shown steady improvement.

Table 1. Summary of the FACET scores for my courses.

	Academic Year	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
IS211	Instructor Rating	5.90	5.90	5.85	5.06	5.59	5.59	5.69	6.08
	Course Rating	5.74	5.83	5.76	4.63	5.20	5.53	5.55	5.93
CS702	Instructor Rating	-	-	-	-	6.29	6.46	6.53	6.69
	Course Rating	-	-	-	-	6.14	6.46	6.33	6.62

In addition, I have supervised two PhD students (one of whom graduated in 2024) and 19 SMU undergraduate students. PhD students working with me have won fellowships and research awards, including SMU's Presidential Doctoral Fellowship, Microsoft Research Asia Nomination Award, and the Google Anita Borg Memorial Scholarship.