Collaborative Research: BPC-DP: Building an Educational Infrastructure for Students at K-12 Schools for the Blind to Broaden Participation in Computing

When it comes to computer programming, blind and visually impaired individuals are at a significant disadvantage compared to their sighted counterparts. Computer programming is a highly visual task, and the modern programming tools that blind users must use are designed almost exclusively for sighted users. Moreover, computing curricula at schools for the blind are nearly non-existent; those rare blind individuals who are able to enter the computing profession are largely self-taught. That the blind are significantly underrepresented in the computing profession is an unfortunate state of affairs, as computer programming offers the blind population both a rich world to explore—one that is potentially accessible through carefully designed auditory cues—and a lucrative career path.

We propose to develop and empirically evaluate a new educational infrastructure intended to address the challenge of significantly increasing the participation of blind individuals in undergraduate computing programs, and ultimately in the software engineering profession. The educational infrastructure, which will be developed in collaboration with five K-12 schools for the blind and a mentorship board of successful blind programmers, consists of three key components: (1) a novel auditory programming environment tailored to the special needs of the blind; (2) a novel *studio-based* computing curriculum that engages students in the construction, customization, and sharing of speech-based virtual worlds in order both to teach computer programming skills and inspire students to consider computing as a career; and (3) a blind-accessible web-based community portal designed to facilitate peer mentoring and support, and to provide opportunities for students to interact with role models who have overcome their visual impairment and succeeded in the computing profession.

In developing a new educational infrastructure for students at K-12 schools for the blind, our project will address two significant research questions: (1) *How can the highly-visual, cognitively complex task of computer programming be made both accessible and engaging to middle and high school blind students through a computing education infrastructure consisting of an audio-based programming environment, specialized curriculum, and web-based community portal?*; and (2) *How can a such a computing education infrastructure be best designed so as both (a) to facilitate its wide-scale adoption by K-12 schools for the blind and (b) to broaden the participation of the blind population in computing?*

Intellectual merits: Through a rigorous empirical approach involving non-sighted students, this project will develop the first auditory programming environment tailored specifically for the blind. Thus, this project will advance the state-of-the-art in auditory programming environments. The auditory programming environment will provide a foundation for the development of a novel studio-based computing curriculum rooted in the construction, customization, and sharing of speech-based virtual worlds, which will provide an engaging and motivating context for blind students to collaboratively explore the world of computing. Finally, the educational program we develop, which will undergo rigorous formative and summative empirical evaluation, will expand the knowledge base on effective educational approaches for teaching cognitively complex skills to the blind, and provide a model for wider-scale adoption.

Broader impacts: Our project will provide the first broad-based implementation of an educational infrastructure for computing tailored specifically for K-12 schools for blind. It will create a new "way in" to computing for a significantly underrepresented population, thereby increasing its participation in undergraduate computer science programs and ultimately in the computing profession. Moreover, the educational infrastructure we develop will provide an empirically-tested model for wider-scale adoption by a broader set of schools for the blind across the U.S. In addition, by empowering blind individuals to create their own technology, our project will provide blind individuals with a means for improving their own state of affairs, helping to end their reliance on software manufacturers that have little financial incentive to focus on them. Finally, results from this project may have effects that last far beyond the specific computing education programs being offered and could lead to significant advances in blind technology, developed *for* the blind and *by* the blind.