ACCESS GRANTED: UNLOCKING ACCESSIBILTY IN COMPUTER SCIENCE THROUGH COLLABORATION

Charity Pitcher-Cooper, B.S.N.
Smith-Kettlewell Eye Research Institute
2318 Fillmore St
San Francisco, CA 94115
cpc@ski.org

Shasta Ihorn, Ph.D.
San Francisco State University
1600 Holloway Ave, EP 301
San Francisco, CA 94132
sihorn@sfsu.edu

Ilmi Yoon, Ph.D.
San Francisco State University
1600 Holloway Ave, TH 910
San Francisco, CA 94132
ilmi@sfsu.edu

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ABSTRACT
This case study examines the unique collaboration between YouDescribe and the San Francisco State University computer science program, focusing on how the partnership enhances computer science education. Beginning in 2019, The Smith-Kettlewell Eye Research Institute Rehabilitation Engineering Research Center on Low Vision and Blindness and the Computer Science Department at San Francisco State University began a multi-year collaborative research project to develop YouDescribeX, a Machine Learning combined with a Human-in-the-Loop AI system that generates baseline descriptions with a focus on scene narrative within videos. With resources and funds from both organizations, plus a generous yearly grant from Ability Central, dozens of students have organized and cataloged valuable research data, built mobile apps, and developed a brand-new interface for volunteer-provided audio descriptions, all while maintaining and supporting YouDescribe.org. In addition to providing crucial research software engineering support, students learned valuable accessible design concepts and developed accessibility advocacy skills, ensuring that online information is compatible with the four principles of accessibility as set forth by the Web Content Accessibility Guidelines (WCAG). We assert that building accessible web platforms from the ground up is a superior learning vehicle, providing practical, engaging education for computer science students while giving them much-needed accessibility-specific computing skills.

CCS CONCEPTS
K.3.1: Computer and Information Science Education - Curriculum • Software Engineering Education • Inclusive Curriculum Design • Educational Technology

KEYWORDS
Video Accessibility, Blind and Low Vision, Audio Description, Artificial Intelligence, Machine Learning

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1.1 INTRODUCTION
One of the most important accessibility features for video media for the blind and low vision (BLV) community is audio description, a separate audio track that provides narration for video elements that cannot be inferred by listening. Invented by Dr. Joshua Miele, the original YouDescribe (YD) platform is a crowdsourced, web-based tool designed to enhance accessibility for visually impaired individuals by providing volunteer audio descriptions (AD) for the world's largest video-sharing platform, YouTube. [1, 2]. The Smith-Kettlewell Eye Research Institute's (SKERI) Rehabilitation Engineering Research Center on Low Vision and Blindness (RERC) aims to discover and implement innovative scientific knowledge combined with affordable tech to effectively tackle the accessibility gap experienced by blind, visually impaired, and deaf-blind (BVI) individuals. They concentrate on developing new technologies and insights that address critical issues for BVI individuals that often go overlooked [3]. Like all non-profits, SKERI has a considerable need for research software engineering expertise to build research tools, to make code-based inventions come to life, and to do maintenance and updates on successful projects [4]. Due to a lack of technical coding support, over time, these proof-of-concept and initial development accessibility tools can depreciate and become non-operational. Without continued software engineering support, as well as continued feature development, it was inevitable that YouDescribe.org would also degrade over time and no longer be a viable software product.

1.2 COLLABORATORS
At the project outset, two key project coordinators fueled the initiative: San Francisco State professor, Ilmi Yoon, and YouDescribe project lead Charity Pitcher-Cooper. With 23 years of experience teaching and mentoring computer science students, Dr. Yoon is driven to make computing accessible to diverse communities. Her ability to manage large-scale projects and her commitment to student success reflect her passion for fostering an inclusive environment in the tech field. Nurse researcher Charity Pitcher-Cooper has been at the forefront of YouDescribe (YD) since 2019. With her extensive expertise in digital media accessibility and a background in public health, she has dedicated herself to empowering communities through education on critical issues. While many engineering and software teams strive to build innovative, accessible technologies they often do so without input from any members of the community they profess to serve. A knowledgeable community partner, such as SKERI, can establish essential software parameters and ensure that the product is developed with the active involvement of the community it aims to support. Dr. Yoon recognized the dynamic research and product development opportunities that students could explore within the mission of YouDescribe. In addition to the maintenance and support of the popular YouDescribe.org, Dr. Yoon proposed development of YouDescribeX, an AI system that combines Machine Learning combined with Human-in-the-Loop that generates baseline descriptions with a focus on scene narrative within videos. The development of YouDescribeX in partnership with SFSU could provide hands-on training in accessible design

and socially responsible AI development to a socioeconomically and racially diverse group of students at a minority-serving university [7]. Together, these coordinators played vital roles in advancing the goals of both YouDescribe and YouDescribeX, creating meaningful learning experiences for students while addressing critical accessibility challenges.

1.3 CURRICULUM

Integrating product software development focused on accessibility into a computer science curriculum is highly beneficial, particularly for master's level students engaged in projects like YouDescribeX [5, 6]. These students typically dedicate two or more years to their projects, often fulfilling their Culminating Experience Project requirements over two semesters. This multifaceted design approach encourages collaborative learning, with students working closely in groups and emphasizing the sharing of knowledge, research, successes, and challenges. In the SFSU Computer Science Department, students choose between two paths for their projects: a Master Thesis or a Master Project, and many opt to extend their work into a third semester to dive deeper into their topics.

For YouDescribeX, the collaborative team structure includes bi-weekly status meetings with Dr. Yoon and regular smaller breakout sessions to integrate newly developed features and tackle coding challenges. Students are organized into two subgroups—one focusing on AI/ML and the other on web and mobile applications—facilitating frequent interaction to address shared needs, such as the GPU pipeline for the various system components. Each subgroup maintains extensive codebases, and new students typically spend their first semester familiarizing themselves with this complexity, while more experienced members mentor newcomers in their second and third semesters. Ms. Pitcher-Cooper attends weekly meetings to provide design feedback and educate students on Web Content Accessibility Guidelines (WCAG) standards. The collaborative environment also includes direct engagement with BVI testers and blind user interface design consultants, ensuring that student contributions are impactful and user-centered. Dr. Yoon has noted that the YouDescribe project fosters deeper contributions from each student, creating a robust pipeline of learning and teaching that effectively supports the development of accessible technologies.

1.4 SOFTWARE PRODUCTS

Over the past six years, master's students at San Francisco State University (SFSU) have played a crucial role in enhancing the functionality of the YouDescribe.org website while developing a range of innovative software products. They have created customer support-focused administration tools and two companion mobile applications that align with the user interface of YouDescribe.org. Additionally, students developed a new describer interface that features two distinct platforms: one that employs conventional script writing and track placement for freestyle descriptions, and another that integrates machine learning and human-centered AI to facilitate prompted audio descriptions with automated track placement, designed to be refined by volunteers. Notable advancements include the creation of "NarrationBot" for baseline description generation and "InfoBot" for on-demand visual Q&A. Throughout this development process, students gained valuable expertise in video captioning issues, datasets, model training, and evaluation methods. Key resources utilized in their projects include the YouDescribed We Archived (YuWa) dataset for machine learning training and the Validated Image Caption Rater (VICR) dataset for ensuring caption quality.

1.5 CHALLENGES

Challenges of collaboration in the project included a small leadership team that relied heavily on the dynamic personalities of its members. While the high autonomy, high trust approach in this case fostered a strong working relationship, it is difficult to predict the success of other collaborations, as poor team fit could easily jeopardize the partnership [8]. Additionally, the turnover of students graduating and transition to the workforce created friction; the handoff of work was not always smooth, with some new students taking 6 to 12 weeks to fully grasp the code, understand the project, and develop an interest in accessibility. This led to a slow development of the software products.

1.6 THE RIPPLE EFFECT

While the stated goals at collaboration outset were quickly realized, the ripple effect on the team was greater than anticipated. Students were not just exposed to accessible and universal UX concepts, they began to make a habit of thinking of accessibility first, for every stage of development. The students were able to try novel approaches, some successful, some unsuccessful and each cohort could re-imagine the project moving forward with the collective knowledge they built together. As the project progressed and milestones were achieved, students increasingly became invested in the long-term success of YouDescribe, while simultaneously cultivating a passion for accessibility. More experienced students took on mentorship roles for newer team members, transforming the Web Content Accessibility Guidelines (WCAG) from a concept regarded as optional into a priority from the beginning of the design process. The longevity of the project created cross discipline stable learning opportunities including education, psychology, and public health.

1.7 CONCLUSION

The broader context of computer science education reveals a concerning trend regarding its impact on ethical global citizenship. A national study indicates that computer science majors tend to score lower on measures of global engagement and social responsibility, with scores decreasing over the course of their studies [9]. This suggests a need for programs to incorporate more ethical considerations, like accessibility, and global perspectives into their curricula. While we did not poll students at SFSU, the cumulated informal quotes from students (Table 1.) over the years for progress reports reflect a dedication to social justice and global awareness. By promoting projects that merge technology and accessibility, computer science programs can cultivate not only skilled professionals, but also conscientious citizens committed to making a positive impact in the world.

Table 1. Shared student ideologies after working on YouDescribe

Ideology	Description
Empowerment through Technology	Students recognize the potential of technology to transcend barriers, aiming to create a more inclusive digital environment where everyone has equal access to information.

Integration of Accessibility in Work	There is a strong belief that incorporating accessibility into projects enhances technical skills and fosters empathy, leading to better problem-solving and product development.
Mindset of Inclusivity	Exposure to accessibility and disability inclusion in educational settings is viewed as essential for cultivating a professional workforce that prioritizes empathy and inclusivity.
Proactive Design Approach	Students emphasize the importance of considering accessibility from the beginning of the design process, rather than as an afterthought, to create genuinely inclusive solutions.
Impactful and Meaningful Work	Many students express fulfillment in working on projects that have a significant impact on the lives of blind users, highlighting the personal and professional rewards of such efforts.
Collaboration and Innovation	Incorporating principles of accessibility not only improves outcomes for diverse audiences but also fosters a more collaborative and innovative work environment.
Commitment to Teaching and Mentorship	There is a desire among students to share their knowledge and experiences with others, hoping to inspire future developers to prioritize inclusivity in their work.

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