AI-Powered Accessibility Mapping: A Citizen Science Approach for Inclusive Public Spaces

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***Abstract*—Urban accessibility remains a persistent challenge for individuals with diverse mobility, sensory, and cognitive needs. While existing tools such as Project Sidewalk, Wheelmap, and AccessMap provide valuable datasets, they often rely on static or incomplete information. We propose a citizen science–driven, AI-powered mobile platform that detects, classifies, and maps accessibility features in real time. Using YOLOv8-based computer vision models and geospatial mapping, our system enables community members to contribute photos and videos of public infrastructure, fostering a participatory approach to accessibility auditing. This work presents the system's architecture, dataset creation, training results, and planned pilot deployment, highlighting its interdisciplinary contributions to human-centered AI, inclusive design, and participatory urban planning.**

***Index Terms*—Accessibility, Computer Vision, Citizen Science, YOLOv8, Human-Centered AI, Inclusive Design, Mobile Computing**

I. Introduction

Physical and informational barriers continue to limit equitable mobility within public spaces. Current accessibility mapping platforms lack real-time adaptability, multimodal coverage, or inclusive data collection mechanisms. To address these limitations, we developed a smartphone-based citizen science system where community members act as active contributors to accessibility mapping. By coupling automated object detection with crowdsourced validation, this project democratizes accessibility data generation while empowering civic planners and individuals with actionable insights.

II. System Overview

The proposed system integrates three core components:

A. Citizen Science Platform

Users capture and upload images or videos of public infrastructure, tagging both accessibility supports (ramps, benches, tactile paving) and barriers (stairs, cracks, missing curb ramps). A peer-validation process ensures data quality and fosters engagement among community participants.

B. Computer Vision Models

We employed YOLOv8n, YOLOv8s, and YOLOv8m models for real-time object detection. These models balance speed and accuracy across mobile devices, enabling adaptive deployment for both newer and older smartphones.

C. Mobile Application

Developed in React Native with a Firebase backend, the mobile app features four primary tabs: Home, Map, Live Feed, and Settings. On-device inference, powered by TensorFlow Lite, supports offline detection and low-latency operation, ensuring usability even in areas with limited connectivity.

III. Dataset and Model Training

A diverse dataset was curated from Roboflow and manually collected images of the Cal Poly San Luis Obispo campus. Images were annotated, resized to 640×640 pixels, and augmented using flipping, rotation ($\pm15°$), and shearing ($\pm10°$). The dataset, consisting of approximately 46,600 images across 10 classes, followed a 6:2:2 training–validation–testing split.

The models were trained for 1,000 epochs using a Google Cloud virtual machine, with performance monitored via mAP@0.5:0.95, loss functions, and inference speed. YOLOv8n achieved the fastest detection suitable for mobile use, while YOLOv8s and YOLOv8m provided higher confidence (mAP $\approx$ 0.73–0.75) but showed signs of overfitting near 1,000 epochs. Common misclassifications (e.g., stairs vs. crosswalks) indicate the need for broader datasets and domain-specific augmentation.

IV. Results and Pilot Deployment

Initial system testing has validated the feasibility of real-time object detection and mobile inference within controlled environments. The YOLOv8 models achieved inference rates exceeding 25 FPS on modern mobile devices, confirming the system's suitability for on-device execution. Preliminary evaluations demonstrate reliable detection of accessibility-related features such as ramps, crosswalks, and tactile paving using live video input.

A formal pilot deployment is currently being planned at the Cal Poly campus and surroundings. This phase will involve community participants who will capture and annotate accessibility data through the mobile app, forming the foundation for a sustained citizen science feedback loop. The deployment will also test usability, data quality, and model robustness under real-world conditions.

Training challenges to date have included GPU resource limitations, large dataset management, and balancing model accuracy with inference speed for mobile deployment. Despite

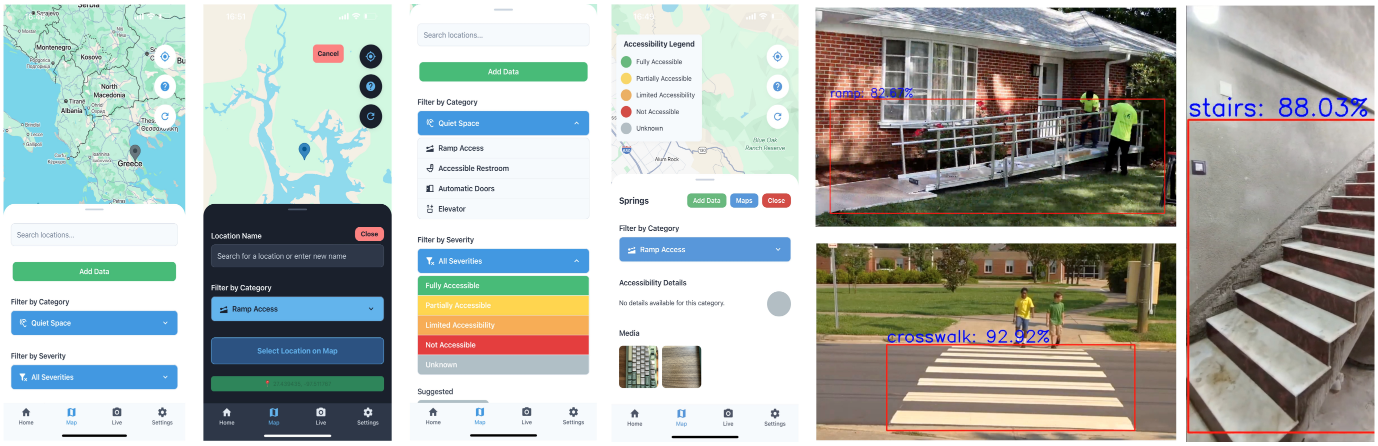

Fig. 1. (Left) Graphical user interface of the accessibility mapping mobile application, featuring search, filtering, and data contribution tools for citizen science reporting. (Right) Example detections produced by the YOLOv8 models showing successful classification of accessibility-related features such as ramps, crosswalks, and stairs.

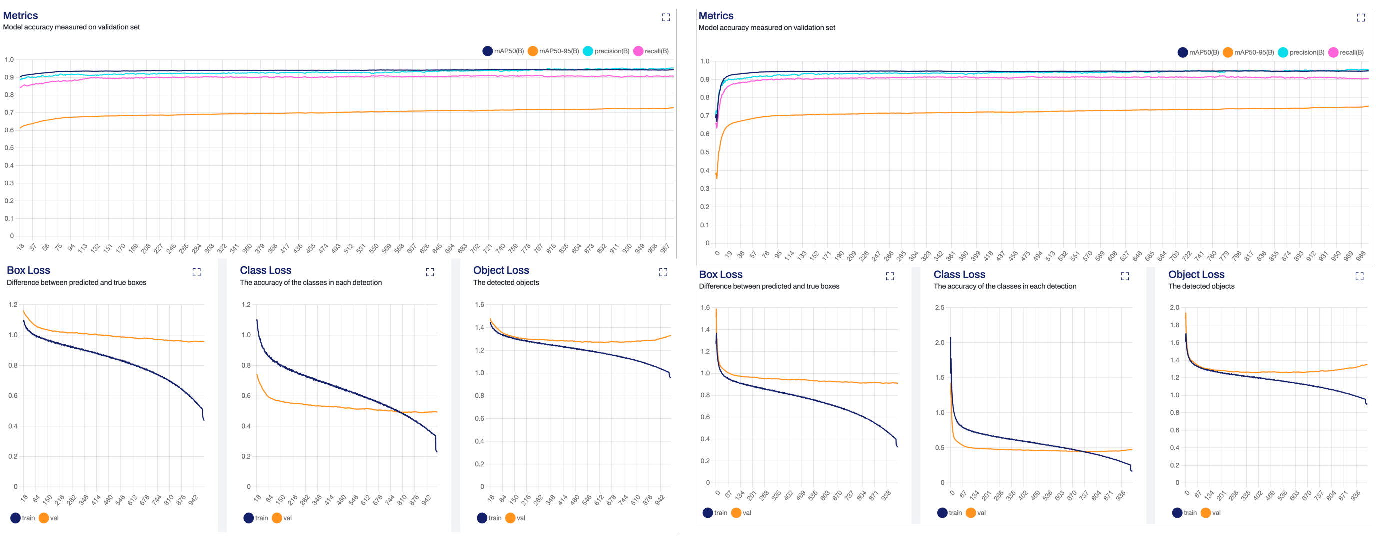

Fig. 2. Model training metrics showing accuracy and loss curves for different YOLOv8 configurations on the validation set.

these constraints, early results indicate strong potential for scalable, community-driven accessibility mapping.

V. Impact and Future Work

This research contributes to inclusive technology, human-centered AI, and participatory urban planning. Its broader impacts include:

- Empowering individuals with disabilities to navigate with greater confidence.
- Providing city planners and advocacy groups with real-time, citizen-verified data.
- Establishing a scalable model for AI-assisted civic data collection.

Future directions include expanding datasets, improving multimodal detection (e.g., auditory or tactile cues), and integrating large language models to summarize and contextualize citizen-reported data.

VI. Conclusion

We present an AI-powered accessibility tracker that unites computer vision, mobile computing, and participatory design to create dynamic accessibility maps. Through community engagement and technical innovation, the system advances equitable public infrastructure and aligns with the goals of human-centered vision research.

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References

[1] M. Saha et al., “Project Sidewalk: A web-based crowdsourcing tool for collecting sidewalk accessibility data at scale,” *Proc. CHI Conf. Human Factors in Computing Systems*, 2019.

[2] A. Mobasheri, J. Deister, and H. Dieterich, “Wheelmap: The wheelchair accessibility crowdsourcing platform,” *Open Geospatial Data, Software and Standards*, vol. 2, no. 1, 2017.

[3] N. Kasemsuppakorn et al., “AccessMap Seattle: Enabling mobility for all through personalized pedestrian routing,” *ACM SIGACCESS*, 2018.

[4] Mapillary, “Crowdsourced street-level imagery platform,” 2023. [Online]. Available: https://www.mapillary.com

[5] G. Jocher, A. Chaurasia, and J. Qiu, “Ultralytics YOLOv8,” 2023. [Online]. Available: https://github.com/ultralytics/ultralytics

[6] F. H. Khan et al., “Authoring platform for mobile citizen science apps with client-side ML,” *Proc. CSCW Companion*, 2021.