AI-Driven Urban Comfort Indicators Assessment using Close-Range Crowdsource Images

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SUMMARY

Urban environments are increasingly complex, not only because of their physical dynamics but also due to the growing demand for the organization, processing, and visualization of data. To be reliable and accurate, such environments must continuously integrate and interpret diverse data sources, particularly for assessing human comfort in areas where people live, work, or visit. Comfort indicators, defined as descriptive representations of real-world urban entities, have become critical in this context. Their integration with artificial intelligence enables the analysis of multi-dimensional data. This research introduces an AI-driven comfort assessment model that integrates diverse indicators into a unified and interpretable framework for urban comfort evaluation.

The proposed framework begins with close-range crowdsourced imagery, complemented by spherical video and shade maps of the specified urban area. Subsequent to this initialization, a structured pre-processing phase is initiated to organize datasets, extract station samples of images or frames, and remove irrelevant elements. Advanced 2D processing techniques are then applied, combining transformer-based and prompt-based semantic segmentation with spatial and noise analysis to derive the highest possible level of accuracy for comfort-related features. These features are integrated within the comfort assessment model, where indicators are normalized, aggregated into a composite comfort index, and further analyzed through indicator scoring to reveal the most and least influential factors shaping comfort.

Results demonstrate that the framework produces reliable comfort maps and semantically enriched visualizations that directly link comfort attributes to their spatial context. Findings highlight the dominant role of green view index, walkability, and vegetation diversity in enhancing comfort, while urban clutter and noise consistently reduce it. Validation against human-based references

confirms the robustness of the model. By embedding AI-driven indicators within an interpretable and scalable workflow, this research advances the quantitative and qualitative assessment of urban comfort. The model not only strengthens the representation of urban form but also provides actionable insights for planners and policymakers, supporting healthier, more resilient, and sustainable cities.