

# GIO.G: A Generator for Indoor-Outdoor Graphs to Simulate and Analyze Urban Environments

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**Abstract**—en-source and configurable tool designed to streamline the modeling process and reduce manual effort. In this paper, we introduce GIO.G, a Generator for Indoor-Outdoor Graphs, designed to address these challenges and enhance pedestrian-focused simulation in urban environments. GIO.G offers configurable parameters such as building characteristics, urban density, and foot traffic congestion levels, enabling users to explore a wide range of scenarios with precision and scalability. Through a series of scenarios, we highlight GIO.G’s unique features and showcase GIO.G’s versatility and effectiveness in generating realistic Indoor-Outdoor Graphs.

**Index Terms**—Data visualization, Data exploration, User interfaces, Graph drawing, Synthetic data, Indoor-Outdoor Graphs

## I. INTRODUCTION

Urban environments are dynamic hubs of activity, where the interplay between indoor spaces (e.g., campus buildings and convention centers) and outdoor areas (e.g., parks and plazas) profoundly influences pedestrians’ daily experiences. Understanding and accurately modeling these interactions are essential for various pedestrian-centric tasks, including developing applications tailored to pedestrian needs, designing efficient and accessible transportation systems, and creating sustainable and livable city infrastructures.

Traditionally, representing urban environments from a pedestrian-centric perspective involves time-consuming manual modeling processes. These processes often require extensive data collection and specialized software tools, presenting a significant barrier to entry for those interested in studying pedestrian behaviors across diverse urban settings. Additionally, while crowdsourced platforms like OpenStreetMap (OSM) [1] provide valuable data, they often lack complete

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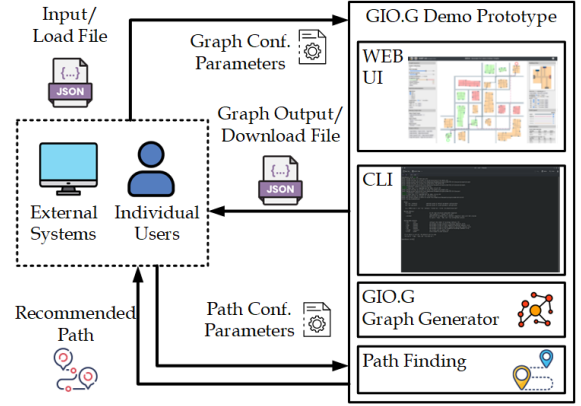


Fig. 1: Overview of the GIO.G Demo prototype system showcasing the data flow and its modules. It should be noted that GIO.G is also usable as a standalone command-line interface (CLI) application without the controller or web-interface.

or consistent information about building topologies, posing challenges for accurate urban modeling efforts.

To address the lack of publicly available pedestrian-focused urban modeling tools / datasets, we extended GIO.G (*Generator for Indoor-Outdoor Graphs*)<sup>1</sup> following the encouragement by the community after our Indoor-Outdoor Graph generator’s introduction in [2]. Indoor-Outdoor Graphs are a hierarchical graph structure shown in Fig. 2 and detailed in Section II.

GIO.G is an open-source and configurable tool designed to streamline the modeling process and reduce manual effort, enabling researchers and practitioners to focus more on scenario exploration and analysis. GIO.G offers a systematic and automated approach to generating Indoor-Outdoor Graphs and synthetic foot traffic congestion data based on user-defined environmental parameters. This scalability extends to large

<sup>1</sup><https://github.com/admtlab/GIO.G>