Recommending the Least Congested Indoor-Outdoor Paths without Ignoring Time

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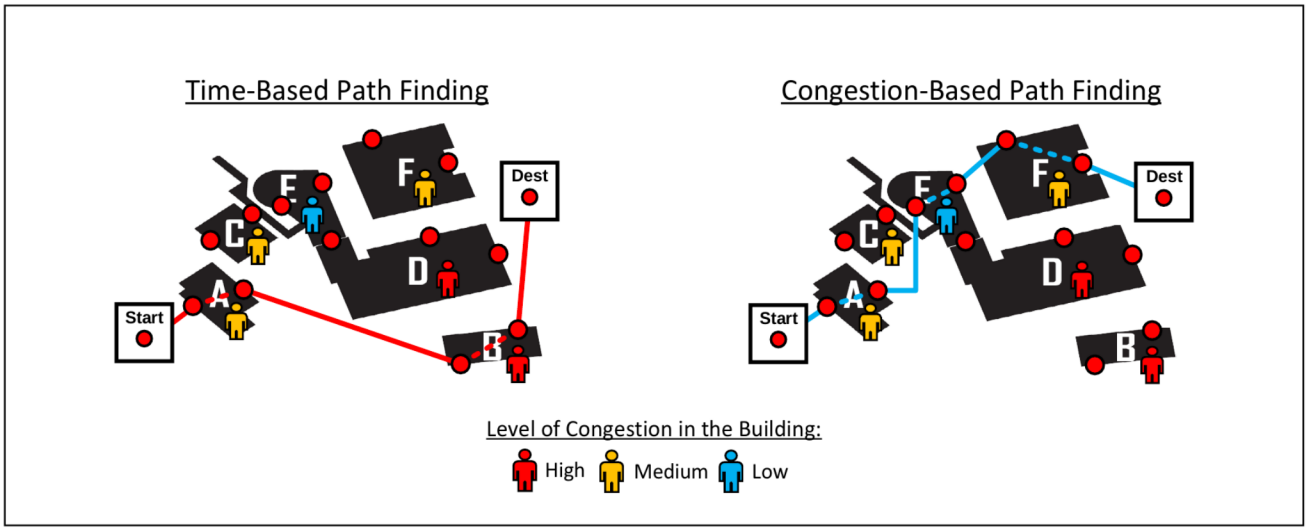

Figure 1: Time-based Path Finding may sacrifice exposure risk in order to optimize for time (left); Congestion-based Path Finding allows us to avoid this sacrifice (right).

ABSTRACT

The exposure to viral airborne diseases is higher in crowded and congested spaces, the COVID-19 pandemic has revealed the need of pedestrian recommendation systems that can recommend less congested paths which minimize exposure to infectious crowd diseases in general. In this paper, we introduce *ASTRO-C*, an extension of previous work *ASTRO*, which optimizes for minimum congestion. To our knowledge, *ASTRO-C* is the only solution to this problem of constraint-satisfying, indoor-outdoor, congestion-based path finding. Our experimental evaluation using randomly generated Indoor-Outdoor graphs with varying constraints matching various real-world scenarios, show that *ASTRO-C* is able to recommend paths with, on average a 0.62X reduction in average congestion, while on average, total travel time increases by 1.06X and never exceeds 1.10X compared to *ASTRO*.

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CCS CONCEPTS

• **Information systems** → **Location based services**; **Spatial-temporal systems**; **Location based services**; **Mobile information processing systems**.

KEYWORDS

Pedestrian Path Recommendation, Constraint-based Path Finding, Indoor-Outdoor Graphs Generation, Indoor Congestion, COVID-19, Crowd Diseases

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1 INTRODUCTION

Given the economic, environmental and quality of life impact of traffic congestion, route/outdoor recommendation systems consider traffic congestion and recommend less congested and less-time consuming alternative routes to a given destination [10]. The COVID-19 pandemic has revealed an analogous impact of congestion and pointed out for the need of pedestrian recommendation systems that can recommend less congested paths that minimize