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Geospatial Modeling Framework for Enhancing Urban Roadway Intersection Safety

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Abstract : Despite the many advances made in transportation planning, the number of injuries and fatalities in the United States which involve motorized vehicles near intersections remain largely unchanged year over year. Data from the National Highway Traffic Safety Administration for 2018 indicates accidents involving motorized vehicles at traffic intersections accounted for 8,245 deaths and 914,811 injuries. Furthermore, collisions involving pedal cyclists killed 861 people (38% at intersections) and injured 46,295 (68% at intersections), while accidents involving pedestrians claimed 6,247 lives (25% at intersections) and injured 71,887 (56% at intersections)- the highest tallies registered in nearly 20 years. Some of the causes attributed to the rising number of accidents relate to increasing populations and the associated changes in land and traffic usage patterns, insufficient visibility conditions, and inadequate applications of traffic controls. Intersections that were initially designed with a particular land use pattern in mind may be rendered obsolete by subsequent developments. Many accidents involving pedestrians are accounted for by locations which should have been designed for safe crosswalks. Conventional solutions for evaluating intersection safety often require costly deployment of engineering surveys and analysis, which limit the capacity of resource-constrained administrations to satisfy their community's needs for safe roadways adequately, effectively relegating mitigation efforts for high-risk areas to post-incident responses. This paper demonstrates how geospatial technology can identify high-risk locations and evaluate the viability of specific intersection management techniques. GIS is used to simulate relevant real-world conditions- the presence of traffic controls, zoning records, locations of interest for human activity, design speed of roadways, topographic details and immovable structures. The proposed methodology provides a low-cost mechanism for empowering urban planners to reduce the risks of accidents using 2-dimensional data representing multi-modal street networks, parcels, crosswalks and demographic information alongside 3-dimensional models of buildings, elevation, slope and aspect surfaces to evaluate visibility and lighting conditions and estimate probabilities for jaywalking and risks posed by blind or uncontrolled intersections. The proposed tools were developed using sample areas of Southern California, but the model will scale to other cities which conform to similar transportation standards given the availability of relevant GIS data.

Keywords : crosswalks, cyclist safety, geotechnology, GIS, intersection safety, pedestrian safety, roadway safety, transportation planning, urban design
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