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Integrated Genetic-A* Graph Search Algorithm Decision Model for Evaluating Cost and Quality of School Renovation Strategies

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Abstract : Energy consumption of buildings has been an increasing concern for researchers and practitioners in the last decade. Sustainable building renovation can reduce energy consumption and carbon dioxide emissions; meanwhile, it also can extend existing buildings useful life and facilitate environmental sustainability while providing social and economic benefits to the society. School buildings are different from other designed spaces as they are more crowded and host the largest portion of daily activities and occupants. Strategies that focus on reducing energy use but also improve the students' learning environment becomes a significant subject in sustainable school buildings development. A decision model is developed in this study to solve complicated and large-scale combinational, discrete and determinate problems such as school renovation projects. The task of this model is to automatically search for the most cost-effective (lower cost and higher quality) renovation strategies. In this study, the search process of optimal school building renovation solutions is by nature a large-scale zero-one programming determinate problem. A* is suitable for solving deterministic problems due to its stable and effective search process, and genetic algorithms (GA) provides opportunities to acquire global optimal solutions in a short time via its indeterminate search process based on probability. These two algorithms are combined in this study to consider trade-offs between renovation cost and improved quality, this decision model is able to evaluate current school environmental conditions and suggest an optimal scheme of sustainable school buildings renovation strategies. Through adoption of this decision model, school managers can overcome existing limitations and transform school buildings into spaces more beneficial to students and friendly to the environment.

Keywords : decision model, school buildings, sustainable renovation, genetic algorithm, A* search algorithm
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