

Methodology to assess Smartness Quotient inherent in traditional Indian settlements

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Abstract:

Smart cities have become a leitmotif in the international political arena and scientific discourses. The study aims to develop a methodology for assessing the urban attributes of an existing traditional settlement that contribute to the goals of urban smartness. The null hypothesis assumes that the traditional settlements are indigenously smart, and it is possible to estimate their inherent smartness quotient despite its fuzzy interpretation. A text-mining and grounded-theory-based meta-synthesis approach is proposed to define a smart city as an urban system that strategically leverages the hidden potential of its existing communities for a livable, sustainable and inclusive urban future. The study develops a smartness quotient index and model to quantify the inherent smartness of an urban system assuming people's perceptions and spatial attributes as proxy for urban smartness. Four levels of abstraction are identified for the hierarchical evaluation of households' responses within the delineated study area of Alwar walled city in north Indian state of Rajasthan. The residents' scores for each variable and indicator are aggregated using fuzzy arithmetic averaging, and all indicators are aggregated using fuzzy weighted averaging operations. Assuming derived smartness quotient as the response variable, an intelligent fuzzy inference system is trained using leave-one-out cross-validation and metaheuristics algorithms.

The comparison with a classical index showcases the advantages of using fuzzy index in terms of its robustness, interpretability, and possibilistic approach. The fuzzy scores shows that degree of tolerance ranks highest followed by perceived sense of safety and cultural freedom and cultural vitality ranks highest followed by collective efficacy and social cohesion, local environmental quality, and travel behavior. A genetic algorithm-based fuzzy inference system taking urban fabric, network topology, and cultural vitality as input variables explains ~ 83% variance. Application of partial compensatory approach, fuzzy linguistic labels, and non-linear optimization techniques enhance the readability, flexibility, and replicability of the model. The study concludes that the existing traditional communities are indigenously smart, and it is imperative to capitalize on the existing social and cultural resources of old cities. The proposed methodology is robust to deal with human-centric systems and provides an efficient expert-driven decision support tool.

Keywords: Smart urban attributes, historic cities, socio-cultural and spatial characteristics, fuzzy arithmetic, fuzzy systems modeling, meta-heuristics