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Semantic-Driven Paradigm Shift in Campus Guide Design Leveraging the KE-AIGC Framework

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ABSTRACT

Campus guide systems are crucial to university infrastructure, shaping the experiences of students, staff, and visitors. Current systems face critical challenges in three areas: capturing diverse user needs, translating emotional requirements into design elements, and integrating campus cultural identity. This study integrates Kansei Engineering (KE) and Generative Artificial Intelligence (AIGC) to propose a semantic-driven design method. Using Semantic Web and Natural Language Processing (NLP), it models demand semantics, extracts emotional semantics such as safety and belonging, and maps them to design semantics for AIGC to generate personalized guide solutions. The approach leverages data-driven emotional semantic analysis and generative models to improve path guidance precision and cultural representation. Results indicate significant improvements in user experience, pathfinding accuracy, and cultural communication, with higher user satisfaction. This method provides a new semantic-driven pathway for developing campus guide systems and development prospects.

KEYWORDS

Kansei Engineering, Generative Artificial Intelligence (AIGC), Guide Systems, University Campus, Semantic Web, User Experience

INTRODUCTION

Campus wayfinding systems are essential components of university infrastructure, serving as both key navigation tools and vital mediums for conveying campus culture and functionality. However, current systems exhibit significant limitations: They often fail to adapt to dynamic user needs, lack systematic emotional consideration in design, and struggle to effectively integrate cultural elements. Traditional wayfinding approaches primarily focus on functional aspects while overlooking the crucial emotional and cultural dimensions that significantly impact user experience and satisfaction. However, in the rapidly evolving educational landscape, the design and optimization of current wayfinding systems face numerous challenges. On one hand, the diversity and dynamic nature of user demand semantics are difficult to capture accurately using traditional methods. On the other hand, designers often rely on subjective judgments to interpret emotional and functional semantics, lacking systematic

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and scientifically quantifiable support. These deficiencies in semantic translation hinder the ability of wayfinding designs to fully address detailed, real-world usage requirements. Furthermore, existing systems are limited in their capacity to convey campus cultural semantics and express emotional semantics, leading to suboptimal user experience and weaker cultural identification. The root cause lies in the reliance on traditional communication methods between designers and users, both of whom lack clear mechanisms for modeling and translating demand semantics into design semantics.

The core of design lies in transforming user needs into actionable solutions—a process fundamentally involving the translation of demand semantics into design semantics. However, this translation has long been constrained by the difficulty of quantifying emotional semantics. Traditional design processes depend on interviews, questionnaires, and other subjective research methods, requiring designers to extract information from ambiguous user statements and visually interpret them. Because of the inherent vagueness, ambiguity, and uncertainty of human descriptions, designers often struggle to accurately refine demand semantics, resulting in mismatches between design semantics and user needs. This "semantic gap" is particularly pronounced in complex, multi-stakeholder environments, such as campus wayfinding systems, where both efficient spatial navigation and the integration of emotional and cultural experiences are critical. Clearly, traditional design workflows require innovative technologies to bridge the gap between demand semantics and design semantics.

The introduction of Semantic Web technology offers a potential solution to this gap (Liu & Yu, 2024). By providing standardized semantic descriptions and knowledge modeling, the Semantic Web structures demand semantics into analyzable, actionable knowledge graphs. This technology effectively captures emotional, functional, and cultural semantics from user requirements and translates them into design semantics through mapping relationships, enabling designers to understand and address user needs with greater precision. When combined with natural language processing (NLP) technologies, the Semantic Web can perform layered analyses of users' natural language needs, constructing a mapping matrix from demand semantics to design semantics to achieve logical translation of multidimensional requirements (Gu & He, 2024).

In this context, the integration of Kansei engineering (KE) and artificial intelligence (AI)-generated content (AIGC) provides new technical support for the semantic translation of wayfinding designs. KE focuses on the emotional semantics of users, analyzing their psychological reactions to design elements and converting abstract emotional needs into actionable design parameters. AIGC, leveraging deep learning and big data, efficiently generates diverse design solutions that align with both demand and design semantics. When combined with Semantic Web technology, KE can improve the accuracy of demand semantic modeling and emotional semantic quantification, whereas AIGC significantly enhances the efficiency of design generation. This integrated approach forms a complete semantic translation loop—from demand semantic expression to design semantic implementation—addressing issues of ambiguity and lack of quantification in traditional design processes.

In this paper, we propose an innovative solution to these challenges through the integration of KE and AIGC, supported by Semantic Web technology. This novel framework offers several distinctive advantages:

- It establishes a systematic method for capturing and quantifying user emotional needs through KE principles, moving beyond traditional subjective design approaches.
- It leverages AIGC capabilities to generate adaptive design solutions that respond to both functional requirements and emotional needs, creating more personalized and engaging wayfinding experiences.
- It utilizes Semantic Web technology to bridge the gap between user needs and design implementation, ensuring more accurate translation of emotional and cultural requirements into concrete design elements.