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SMART STREET FURNITURE DESIGN: TYPOLOGY RESEARCH

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By examining the conceptual delineation and historical evolution of smart street furniture, this paper aims to refine the theoretical framework for its design and delve into the essence and features of its modernization. Concurrently, through literature review and typological analysis, this study draws upon the achievements of existing research on traditional street furniture classification. Coupled with an analysis of case characteristics of smart street furniture, it conducts a classification study and proposes two distinct classification methods.

Key words: smart street furniture, street design, environmental design, furniture design, public space

INTRODUCTION

Against the backdrop of the development of emerging information technologies such as artificial intelligence, the Internet of Things, and big data, smart cities have emerged as significant topics and directions within the global wave of urbanization. As part of the urban modernization and smart development trend, certain street-level public facilities are in urgent need of large-scale improvement and renewal. It is within this context that the concept of smart street furniture has emerged.

PURPOSE

Due to the fact that smart street furniture represents a novel type within the realm of urban furniture, its conceptual definition remains relatively vague and lacks consensus within academia. This paper seeks to address this issue by delineating the concept of smart street furniture through conceptual clarification, literature review, and typological analysis. It aims to outline its design attributes and elements, thereby enhancing the theoretical framework for the design of smart street furniture.

RESULTS AND DISCUSSION

Scholars have proposed their respective viewpoints on the definition of smart street furniture from different perspectives. Wu Huilan argues that "smart street furniture" refers to public facilities that provide comprehensive services for urban residents based on advanced information technology [1]. Building upon this perspective, Zhou Bo further evolve the concept of smart urban furniture,



considering it as an integration of artificial intelligence, urban monitoring systems, the Internet of Things, smart sensors, and other digital technologies on the basis of traditional urban furniture [2]. This integration aims to construct an efficient and convenient urban public facility management system, thereby elevating urban furniture to the level of intelligence. Broadly defined, smart city furniture encompasses characteristics such as human-centered design, ecological compatibility, and alignment with urban culture. In contrast, the narrow definition solely refers to the application of digital technology in the field of urban furniture.

Smart city furniture, due to its target design innovation, differs in classification and evaluation from traditional urban furniture. Academic research on the classification of smart city furniture is also relatively scarce, often focusing on the intelligent upgrading methods and strategies of single types of street furniture, such as the case studies on Istanbul Yildiz Technical University bus station design conducted by scholars like G.F Caymaz [3]. Alternatively, there are case studies on the smartification transformation of urban furniture in a specific city or region, such as Hassanein's research on Cairo's urban furniture [4].

By examining the existing classification of traditional urban furniture by various scholars and statements on the design and functionality of single types of smart street furniture, this paper further explores the typology of urban furniture from the perspective of smart cities. Smart street furniture can be classified into three categories based on the way and degree of influence through digital technology: adaptive street furniture, innovative street furniture, and artificial intelligence street furniture.

Adaptive urban furniture emerges as a new type of urban furniture updated to meet the sensing, integration, and analysis needs of smart cities with new technologies. Its characteristic often involves adding sensing devices or intelligent modules on top of the basic functions of existing urban furniture, thereby achieving smart upgrades. Such urban furniture typically appears as end-point interactive facilities in smart cities, such as smart streetlights, intelligent billboards, smart bus shelters, and intelligent trash bins.

Innovative smart street furniture, on the other hand, arises from societal demands, new technologies, and economic models. Examples include various civic sharing facilities spawned under internet technology and the sharing economy model: shared bicycles, shared power banks, and shared libraries. Similarly, the development of new media technologies results in interactive installations in public spaces such as streets and squares, such as voice-controlled music fountains, light-sensitive smart parasols, and infrared sensing artistic installations.

Artificial intelligence street furniture exhibits characteristics of robotics and higher-level intelligence. This type of street furniture often transcends the static form of traditional facilities, representing revolutionary products emerging from the current symbiosis of urban information interconnection and the explosion of artificial intelligence. Examples include smart autonomous logistics vehicles, and intelligent autonomous garbage trucks.

Smart street furniture can also be functionally categorized under traditional classification methods, but subcategories should be differentiated based on their



smart characteristics. This classification method still divides them into six major categories: service, municipal, transportation, information, safety, and landscape. Within these categories, service facilities encompass convenient amenities such as smart parcel stations, smart sunshades, smart guide signs, and smart vending machines. Leisure facilities include smart pavilions and smart seats, while recreational services include interactive entertainment devices and smart fitness trails. Municipal facilities include sanitation facilities such as smart trash bins and smart public toilets, environmental facilities such as intelligent environmental signs and recyclable garbage bins, and power distribution facilities such as smart electrical boxes and distribution stations. Transportation facilities include smart road signs, intelligent duty police kiosks, and smart traffic signal systems. Information facilities comprise smart bulletin boards, smart wayfinding systems, and smart billboards. Safety facilities include intelligent warning devices, smart security systems, and smart lighting systems. Landscape facilities encompass smart pavement, intelligent lighting, smart landscape flower boxes, smart landscape tree pits, interactive art sculptures, and intelligent public installations.

CONCLUSIONS

In the classification study of smart street furniture, the article proposes three categories: improved street furniture, innovative street furniture, and artificial intelligence street furniture. Additionally, according to traditional classification methods, smart street furniture is divided into six major categories: service, municipal, transportation, information, safety, and landscape.

Through conceptual delineation and classification research of smart street furniture, the article delves into the design theoretical framework of smart street furniture. It provides significant references for smart city construction, emphasizing the importance of the application and development of digital technology in the field of urban furniture for enhancing urban life quality and promoting intelligent urban management development.

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