



Urban Interaction Design Supports Modular Design Practice for Urban Public Space

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Abstract. Multiple-dimensional structured urban space directs to an interdisciplinary considers on public space utilization. The people-users are consciously and unconsciously in the communicative activities with the city, where urban interactive design establishes cross-design accessibility in the virtual and physical public context. This paper introduces an approach that the Human-centered Design as a fundamental perspective and Interaction Design frames the program and motivates design elements for urban interaction design. Following a Smart Pavilion design practice for Baoding New City Plan in China. Particularly conception of this design is the four modules creation of Information Block, Pavilion Block, Interior Block, Information Platform Block, and the attempt on organizing the modules to constitute three prototypes for different scenarios. People's real-time requirement, reflection, and emotion can be captured by interfaces and delivered to the information platform towards a transfer qualitative symbols into data essentially design and improvement materials, and react to the Smart Pavilion to enable the Human Interactions in the 21st-century networked city.

Keywords: Urban interaction design · Human-centered design · Modular design · Public space

1 Background

In China facing complex problems from facilities, governance, and society, that results in city emphasize the interaction between people and the city itself seeking to urban public space regularly. Booming population, diverse functional requirements and urban quality standards lead to a single public space design encounter bottleneck. Though the public space refers to a place that is open and accessible to all citizens; prominent cities emerges a calling for the collaborative interdisciplinary-workshop on the relationship between built environment, economic development, and the social culture relations behind. Urban designers need to face the challenges:

- 1- How to create a functional and extensible design for multiple-requirements of citizens?
- 2- How to highlight and tackle people's feedback and transfer it to advance design timely and accurately in urban public space?
- 3- How to react to citizens' reflection and emotion?
- 4- Can the urban public space link citizens' communication?

Urban is a hybrid subject where various sectors of society are seeking solutions, and among that, urban design particularly contributes to spatial practice because of its focus on the quality of urban space for citizens. However, what influences urban space refers to comprehensive factors, and who guides a sustainable urban space exists uncertain stakeholders' responsibilities. Since the information revolution era has begun, preliminary urban programs and practices have been asserting its powerful position owing to Human-Computer Intelligence developing rapidly in the smart city context. To face this era, China's urban design exploration started from smart designs for holding technologically attitudes to create and cultivate interactive interfaces of the city by using data as a communication language for planning, design, management, and prediction.

2 The City as an Urban Interaction Design Platform in Smart City Context

Urban interaction is a cross-disciplinary that combines spatial and technological factors to support design brings a creative approach and objects into citizens' surroundings. The Urban signifies the fundamentality on spatial aspects that affect human behaviors, emotion, and relationships, drawing on approaches from the social sciences. This space has become large and fluid, distributed and complex. It is filled with data streaming from various types of sources. "Interaction" refers to technology, particularly communication and networked technologies that convert the raw material of data into meaning that informs our decisions at scales that range from citywide solutions to grassroots hacking and tinkering.

From urban interaction design perspective, interactive design innovates the way we benefit from Smart City, actively adding the understanding for which facilities, devices, and apps that links city people and space. From the spatial environment perspective, is the practice of designing Smart City products or services, such as interactive digital products, environments, systems, and services, involving users actions and emotion into local shared space.

The public is involved in the urban interactive movement, and influences the city by the interactive activities that Individuals as creators, carriers, and sharers of data. Bottom-up approaches that towards improving a human-centered urban space have paved the way for citizens to become an element involved in the servicing-interactive processes associated with the making and remaking of cities. The human-computer interaction (HCI) and related fields, such as computer- supported cooperative work, cyber-physical system, interaction design, and urban computing or the Internet of Things, the rapid expanse of urban issues has fostered a parallel uptake of concepts

from different disciplines such as ethnography and design, and shift from “interfaces” towards “interspaces”. At one end of the spectrum, with the help of smart cities technology, interfaces of infrastructures, dashboards for networks and the central operation platform supports navigating design for sustainable development systematically.

3 Approach

For advance urban interaction design for human-centered cities, this paper state a converging approach as the public interaction practicing multiple-disciplinary collaborative process. Human-centered Design claims a human perspective and interactive design supports to direct the problem-solving conduct.

3.1 Human-Centered Design

As an approach to interactive system development, Human-centered design aims to make usable and useful system form a user-centered perspective. It focused on the users needing and requirement by applying human factors, usability knowledge, and techniques. Human-centered Design and Urban Design have a seeming similarity on design perspective of the human, while Human-centered Design has distinct empathize on engaging the user into the design activities, which as named the participatory design. In the design process, the human-centered design generally defines the problem, make prototype, test, and those processes together with the designer and the user, which supply the vacant urban space design designer. The real-world users of the urban space know what they are looking forward. It can be announced that the human-centered design bridge users and space from the bottom-up situation.

On account for citizens in urban public spaces in divers, the current design tends to appeal to more demanding needs due to periods for a multilevel usage of the limited urban area. For example, a square, as a pass way for office workers in the morning, a community space for the elderly in the afternoon, and a square dance venue in the evening. If it provides space for selling breakfast in the morning, showing broadcast news in the afternoon, and playing music in the evening, it will be very convenient for the crowds—however, this usage planning seeking solution relay on facilities and equipment advancing rather than space dividing. Thus, when the center of problem-solving returns to the actual needs of people, urban design is forced to cross the current discipline.

Human-centered design typically attempts at integrating technology and productive tools in order to alleviate problems with the centered focusing on human requirement and feeling, especially design as the dominant pattern facing a complex functional and aesthetic city requirement.

Interdisciplinary design collaboration proposes new ways of designing methodology. Outstandingly with disciplinary distinction, the human-centered design provides a starting point and the implementation proximity perspective following the urban interaction design. For example, on the 2014–2018 Challenging the City Scale project of European Human Cities (Humancities.eu) brings great repercussions to the urban

community space by reshaping the urban space, fostering culture identification and activating street value. It aims to establish a co-design pattern with various city managers, planners, designers and users from a human-centered perspective. The deliveries include urban design, product design, visual design, network design, and civic events, among that 70.7% of the projects embraces practical design while 12% projects have the symptom of interactive design (Fig. 1).



Fig. 1. Unlimited-cities DIY project of Europe Human Cities

3.2 Data-Streamed Urban Interaction Design

Interaction Design, often abbreviated as IxD, is “the practice of designing interactive digital products, environments, systems, and services.” (Cooper et al. 2011) It specifically inspires a creatively design thinking—generating alternatives, visualizing new possibilities, challenging inherent assumptions, and opening recognition to new information. Interaction design is useful in creating physical products and researching how users interact with the deliveries. Compared with industrial design and urban design, interaction designs focus on user behaviors form the synthesizing and imaging things potentially and explores the connection between the human and things forward reaching and planning users’ requirement and calling for empathy and understanding of the users.

Urban Interaction Design (UrbanIXD) can be seen as being grounded in the traditions of society, technology, and arts. It explores the design processes involving the design of interfaces, living activities, and people-using that is happening in an urban context. While media architecture focuses primarily on the built environment, urban interactions tend to highlight the complex situations in multi-functional scopes. Urban stuck in the condition of complex requirements and issues, calling for an attempt to spatial reshape progress. Information technologies presents a multilevel interactive interface and technical possibilities, and construct a straight talking between the city users and city surroundings. Cites are being touched with sensors and interacted with mobile technologies that are generating a myriad of urban informatics experiences.

In particular, interactive design for public space as an approach delivers a human-centered design perspective as well as a broad range of understanding, definition, and narratives that fit into the toolkits of urban interaction design. Creative design

conception emerges between the lines, in space where the designer used to set the boundary with experiences flourish and dramatic statements. While interactive urban design tends to emphasize the complicated situation in multi-functional spaces by building environment and individuals urban experience, data as a new communicating media vocabulary appears in front of urban designers and managers. Design base on reading data forms interactive feedback more than reading academic knowledge and living experience.

Standing in the middle of the urban design and interaction design, urban interaction design general adopting a traditional method of Mapping, Prototyping, DIY by Interaction Design [book]. Those methods are seemingly extracted from the traditional product, information, and urban design, while that embedded with electronics, software, sensors, and network connectivity techniques. In urban space, a flexible design process can help bridge the linkage between fields and advance a general and effective new design vocabulary that beyond sketching blueprint (Brynskov et al. 2014). The interaction designs aims to embracing a reflective, collaborative approach to research and practice that embodies the trans-disciplinary position of urban interaction design.

3.3 An Initiative Interaction Design Model for Urban

This paper is an attempt to combine human-centered design and interaction design facing multiple-requirement of space. The human-centered design reminds a sustained process integrating users tracks. The interaction design presents design elements and philosophy systems to support innovation. Because the design process at this time integrates the physical and virtual space, the cyber-physical system that runs through the dimensions and elements is a surpassing substance, and it also effectively controls the virtual space (Brynskov et al. 2014). So another central control hub throughout should be proposed since the public design platform in the interaction design. Advanced research proposes a design platform as an application program interface (API) complex to relate urban life drove data in terms to establish resources of data flow.

On the input side, users' location, action, and emotion mean a useable description form the facilities and sensors in the public space. Location often comes from apps' feedback data, while it addresses with behavior mapping to reflect movement. The action is mainly divided to touch and speak; the former one enables connectivity between human mental object and technical operation system while the latter one has become an alternative interaction stream with the development of artificial intelligence in China. Emotion is the most untouchable and unidentifiable for design understanding. All surroundings can be heard, smelled, seen by people who tend to express their feeling by writing on the network website, apps, and platform. All the informative mental and behavioral states captured on design platform, which invokes the accessibility of users unconsciously and consciously engaged in public space, therefore facilitate a real-time definition of subjective construction.

On the other side, designers, managers, and administrators co-work based on the data directly, designers and professors research urban interaction design indirectly. When describe the public space and re-innovate space properties, urban design can have a synthetically situation definition that combines interactive users feedback more than a

simplified spatial analysis. Product design, information design, and computer science are set to appropriate access to the urban design by data communicating method. At the same time, citizens are motivated and inspired to take action in the guided direction to contribute reflection, vision statements address their goals and a common cause that commit to their vision. Urban interaction design supports an urban design living-lab standing on the multi-disciplinary field (Fig. 2).

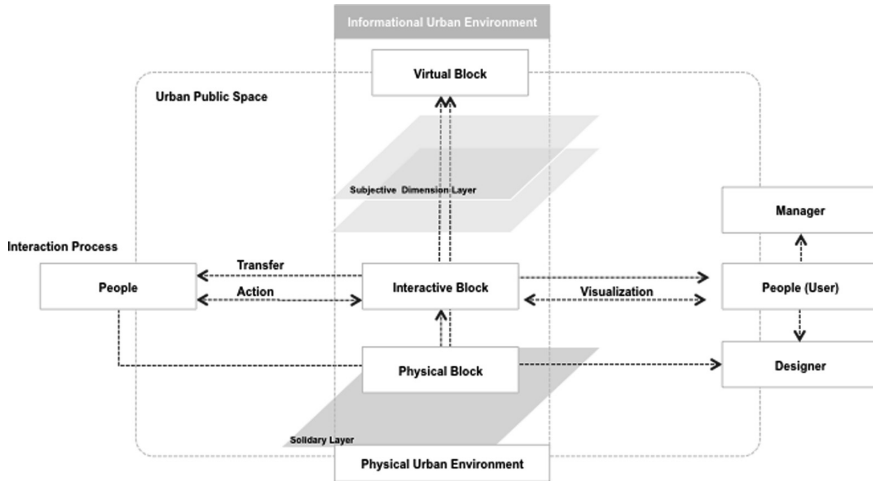


Fig. 2. Urban interaction design model

4 Design Practice—Smart Street Pavilion

4.1 Background

Baoding is China’s National Historical and Cultural City and National Garden City, as well as the China’s first innovation-driven development model city and WWF Low-carbon Pilot City. In April 2017, the State Council of the Communist Party of China decided to set up the Xiong’an New District of Hebei Province, which initiate the three divisions of Xiongxian, Rongcheng and Anxin that Baoding City involving. A new perspective developing program that aims to institute into a new urban plan that drives the development of Beijing-Tianjin-Hebei city’s innovation drive for a future-leading urban space.

However, as Baoding generated in the third-tier cities, obviously urban spatial opportunities in the existing urban structure cannot be neglected: an uncompleted urban space open-system; insufficient and fragmented urban public space without connectivity with the citizens; disorderly outdoor information interface floating over the city appearance (Fig. 3).

In this era and the development of the country, Baoding New City General Planning directs to launch out based on solving the existed urban space problems to create and innovate a human-centered public space with the technological support of smart



Fig. 3. Baoding map and street scenes

city and infrastructure construction objects. Drafting a vision statement for a innovative and interactive city, design concepts:

- 1- A modularized design meeting the contemporary mega polis well-being definition.
- 2- A flexible concrete available carrier for the historical and cultural city.
- 3- A real-time platform with citizens participating.
- 4- A multi-functional urban living-lab encouraging technology possibilities.

4.2 Function Definition

The urban public spaces used to be designed and planned for all city's resident and tourist groups, involving men, women, and children by professional expertise. The design incorporates various types of stakeholders who are designed and thought by architects, UI designers, IT designers, city managers, and residents together jointly conducted a brain-storming section to anchor the functional design positioning. The informal discussion workshop reveals the integrated proposing, and the dimension of the functional realization form division into urban informational and physical space, where has the service similarity center of city people. The function points included street scenes, retailing, information visualization, and so on.

At the same time, interdisciplinary cooperation unavoidable have a disciplinary background through the subject attributes to proposed function, which can be practiced according to the differentiation of the implementation approaches into several aspects, including Urban Design Elements for Usage, Urban Design Aspects for Space Quality and Interaction Design for Information Transfer. Urban interaction designer has penetrated the virtual and physical space involving the cross-directional practice (Fig. 4).

4.3 Modular Design

The next step is a practical modular design propose to make the design programming and development instruments accessible to these users so that rather than just suggesting improvements and new features, citizens can try to create their tracks and ideas to a better urban space.

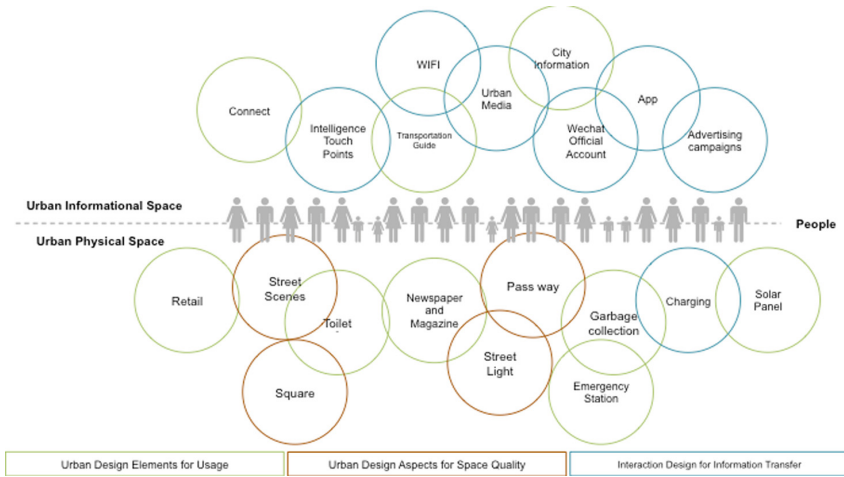


Fig. 4. Function definition mapping

As multiple infrastructures in the public space of the city, a basic **(A) Pavilion Block** to shelter from the rain and enhance the visual experience in the outdoor activities in the city is a fundamental block. Equipped with a large-span roof, the Pavilion builds fragmental walls that define consecutive spaces for possible space and a wooden bench to provide a piece of comfortable underarm equipment. What is improved this time is that the Smart Pavilion carries the solar panel roof to achieve the clean energy as much as possible.

Secondly, it is the **(B) Information Block** that is the response for interaction pattern, which integrates urban media and interactive interfaces into the infrastructure. The essential accessories include LED touch screen performance, audio, camera, voice recognition components, real-time execution of user commands and collection of users’ feedback. Regarding the planning of circuit equipment, digital media related equipment such as WIFI transmission points, charging piles, and telephones are also deployed here to realize the smart city life experience.

Besides, an alternative section holds the **(C) Interior Block**, which aims to service space for indoor using attached on the pavilion frame. Working as a CAFÉ and a food-selling standing to service quick-making food and drinks can affect people into outdoors activities. Having toilet service is also a humanistic concern in the modern city. Newspaper and magazine borrowing service is facing the older adults who are interested in the entity literature. This measure recommends introducing interflow of the population for bridging community communication. In some situations, the retailers can be replaced by auto retailers.

Finally, the **(D) Information Platform Block** is conducted out, which is a site established in the smart city central control system to acquire data and control entity objects through wireless devices remotely. The platform system includes a remote control system and connectivity to handheld devices, which enable a people to scale communicating on Apps, Facebook, Twitter, Wechat official account, and Sina Weibo,

and the latter two created the most using interactive interfaces in China’s current cities. When the public use the Wechat public account and the mobile terminal app to issue commands, accept and input information to the (A), (B), and (C) modular, thereby the design realizing the interaction between people and devices, and then bridge people in the city, such as finding city information, playing music and purchasing food. The generated data in these processes will be collected and stored by the platform system for the next stage on design reflection, design iteration enhancement, and research data foundation for urban interaction design (Fig. 5).

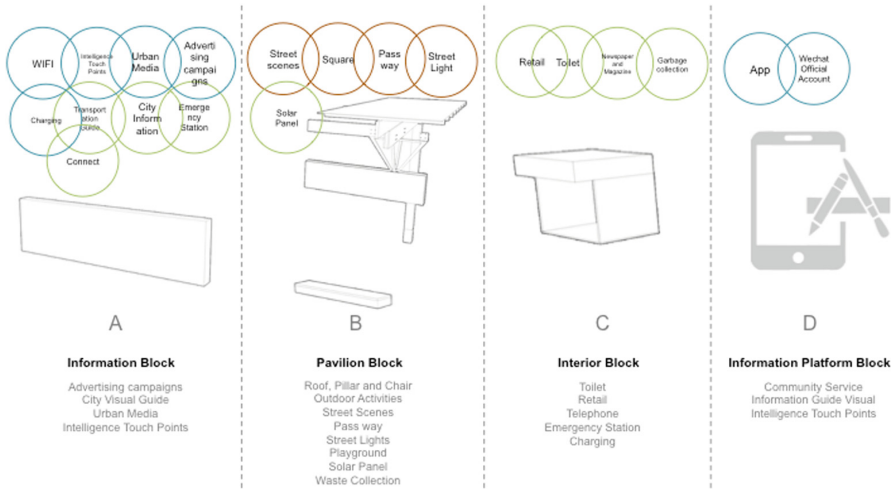


Fig. 5. Modular design

4.4 Prototype Generating and Interaction Design

A further attempt of this research is to organize the module for a suitable prototype to reach various urban living scenarios. According to the Baoding Urban Planning emphasized attention, firstly design needs meet the needs of transportation station, civic activity plazas, and civic parks square. The next generation of prototypes is similar to a human-centered function selection and integration process. Those modular provide possibilities for critical space usage, ultimately making the flexible design connectivity of architecture, hardware, and software design (Fig. 6).

Prototype I

It is a deepening adopting to the traffic station space proposal. Selects (A) Pavilion Block, (B) information Block, and (D) Information Platform Block. Users can access inquiry real-time traffic information, geographic location, weather, and tourism information through mobile screens interface. (D) Information Platform Block is a continuous design platform for information delivery. Along the street at Baoding, it is regularly to see the most people excess circulation rather than the amount of waiting. For passing-by viewing scenario, the Smart Pavilion as a street traffic booth attracts

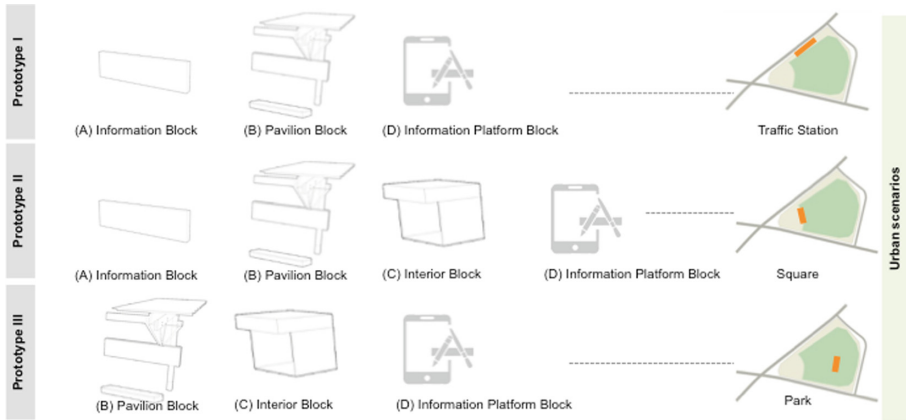


Fig. 6. Prototypes for city scenes

visitors and generates a glanced imagination. Therefore, it has the responsibility to provide city information closely related to daily travel and promote the spread of history and culture of the city with a relatively complete “smart city” technical function.

Prototype II

As a pavilion in the city square, it is an accessible space where people assemble in the morning and evening, where the design needs to add appropriate public infrastructure for affording necessities. The design of Prototype II combines all the modules of (A), (B), (C), and (D). The commercial sales and public education propaganda functions can be realized while meeting the outdoor activities of urban passers-by and attracting people to integrate into space. Interactive devices, such as the self-service interactive furniture and adjustable lights, allow surviving spaces to achieve a wide variety of functions at times of the day and to communicate with users.

Prototype III

Assemble the module (A), (C), and (D). Baoding City’s urban public green space requires equipment for community activities and events. Therefore, the facilities placed inside the city park present a refreshing space for rest and help the simplistic sales function. Rest or stay hereabouts waiting for people to have a conversation with the people around and the activity space.

The three connected prototypes communicate on the design platform, which as the central management system to link the physical construction of the pavilion, information interfaces, and users’ action and emotion. On the one hand, the city management through the information block and pavilion function practice management in the urban working sequence through media, function, and interface. On the other hand, people access and participate in the public space by touching, and speaking based on an operating system that technologically supported by interactive services. The key to the design is interactive virtual-physical design in urban public space to present—how the features interactively design from the public (Fig. 7).

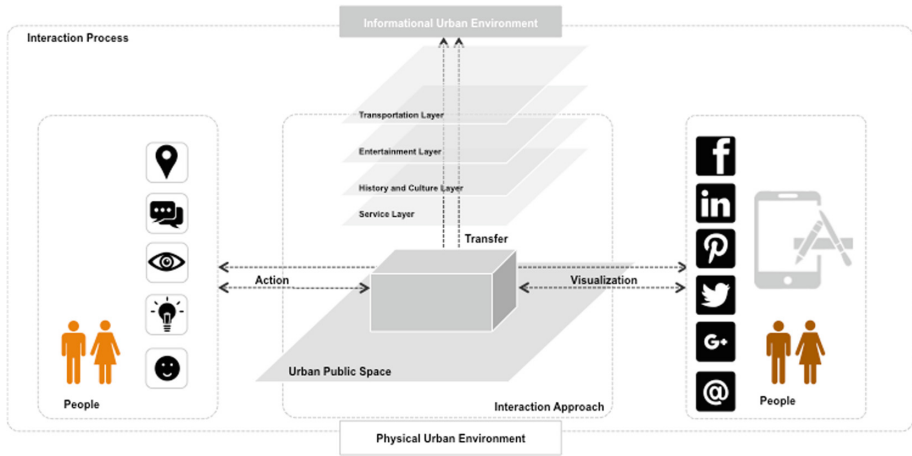


Fig. 7. Urban interaction design system of Smart Pavilion

Actually, the physical and digital contexts are similar. The appearance of digital objects reflects the intrinsic properties the physical analogs. These practices illustrate approaches enrich each other then making an exhaustive list of specific methodologies or techniques used in urban interaction design, that supports a further exploration in a virtual and physical space design context. Multi-disciplinary approaches enrich each other. As designers, the co-design team strives to craft interfaces, systems, and devices that enhance productivity, facilitate our actions, meet our needs, create value and even provide enjoyment.

4.5 Material and Components

At the fundamental concerning, the materials of the designed physical structure are advocating the low-price construction principle and environmental protection to be flexibly combined and re-designed.

Design applies Bamboo Steel as the pavilion frame constructional material, which comes from advanced bamboo industry in China. Particular designed steel connecting member to join components from the pillars bottom to cornice top. The enclosing wall sorts to use sesame ash granite for a permanent performance on the human-scale. The roof mostly made by Aluminum magnesium manganese alloy roofing board while partly covered by the solar panel to generate energy by itself. Water permeable brick covers the floor to support the water cycle in an urban context. The style of pavilion constructional aesthetic tends to a less decorative molding that to present functionalism (Fig. 8).

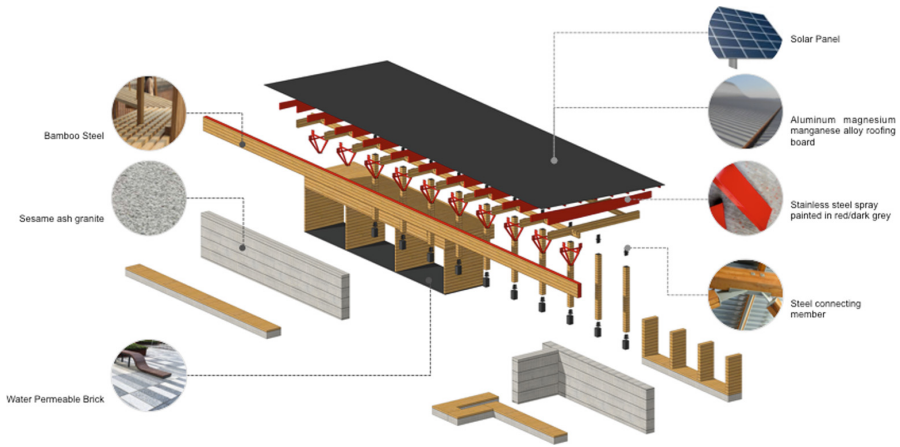


Fig. 8. Tangible material description

The improved design aspect is the focus of this practice. In order to achieve the design function planning of modular, the device and component supported by the ICT technology are used as the data terminal, which Includes: LED display. As a new type of outdoor media, LED integrates public information, corporate advertising, traffic guidance, multimedia display, information release, and human city interaction. Outdoors food court, which offers food and drink provision, can drive the activity of a region. WIFI, locally coverage the facility-centric wireless network. Hotspots are set up in densely populated areas to facilitate the daily necessities of facilities and attracting more users. Outdoor Charging Power Pedestal meets the creative and diverse demands of the ICT era. It will facilitate the modern life with the increasing the popularity of the types of equipment and make people stay longer (Fig. 9).

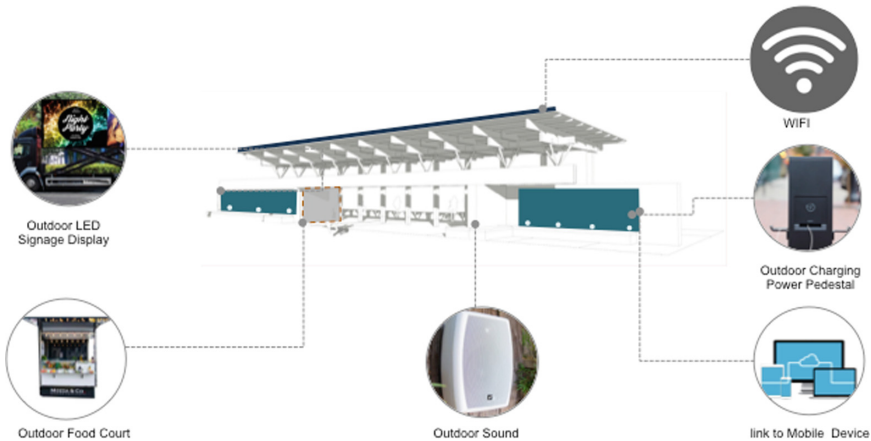


Fig. 9. Advanced interactive components description

5 Conclusion

It is practicing the urban interaction design approach, the Smart Pavilion design particular attempts four modular design blocks for extensive function in limited public space. A pavilion existed throughout virtual and physical dimensions for tackle qualitative users' actions and ideas in a digital form, which promotes the accuracy and timeliness of people's space interaction. Although it needs time on testing of citizens' engagement, it is affirmative considers that the interface has connected users with the city by information transmission.

The traditional urban design tends to follow the approach from the up-bottom perspective, resulting in the inherent professional direction of the disciplinary design deliveries in position with the industrial landscape of the manufacturing era, however, have to admit that it has touched the bottleneck. Urban Interaction design is an interdisciplinary co-design attempt. The project focuses on the objective is to articulate people vision to the designers and managers who actually directs the program and make users idea a substance. Human-computer interaction technique has the potential competitive advantage to stable and inspire innovative design and understanding the broader urban environment in which design operates, and to establish a particular system. The complex needs of the city sort into data streams, which are used to analyze and solve problems, and link people's actions and emotions with space design and planning management.

Urban interaction design processes accessibility existing conceptions of urban space design and citizens, demands by new and shared design vocabularies that bridging the connectivity that appears between systems and disciplines. The vocabularies extend physical aspects to virtual-physical linked approach and emphasize the platform procedure involving citizens reflection and action. Smart City Operating System enables user experience and software solution by data interaction, then the sights, resources, and opportunities converge on the urban interaction design platform.

The viewpoint that the Pubic has the capability of design and innovate city space, ICT allows individuals to participate in urban management through API. The interaction between people and cities has been inadvertently carried out silently. As smart cities operation system takes over the central urban management, data plays an essential role as a universal language actor. The interface is responsible for the communication platform for various disciplines and stakeholders. The design approach with people and functions as the core gradually becomes the interdisciplinary consensus of cooperation.

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