Chapter 10- The Future of the Smart Island: A Design for a Natural and Technological Experience District on Huangguan Island

Abstract: With the environmental improvement and smart city construction, the call for smart design has risen great attention. In addition to the future human settlement we interpret in Chapter 9, the new way for recreation and tourism needs also to be discussed. This chapter takes the Huangguan Island as the design site and combines the traditional spatial intervention and emerging digital innovation methods to design a smart island. Multi-sourced data is analyzed to reveal the present situation, existing resources and advantages of island to help find out design strategies under the support of Data Augmented Design (DAD). Based on this analysis, a physical ring called smart "O" is constructed to connect the Huangguan Island with surrounding areas, regarding them an integrated district. Then, involved with various sensors and AI (Artificial Intelligence) technologies, four aspects of strategies and four systems are proposed to explain how to build a "scientific and technological natural experience" in the physical space. Eventually, the "O" ring contains various functions such as monitoring, transportation and information with the version of "online and offline interaction" and "virtual and realistic experience".

10.1 Introduction

New developments in technology and science have drawn substantial attention worldwide since the last century and motivated designers and researchers to investigate the potential of applying new devices and techniques to change people's lives and environments. With the wide diffusion of the concepts of the digital city and the smart city (Dameri 2013), in addition to governments and organizations, planners and designers have also realized that tremendous advances will result from new technologies. The smart city includes many aspects, such as natural resources and energy, transport and mobility, buildings, living, government, the economy and people (Neirotti et al. 2014). Worldwide, most metropolises, including London, New York, Seoul and Tokyo, have already created strategies for the development of smart cities. In China, the Ministry of Housing and Urban-Rural Development (2012) issued the "Notice for the Pilot Work on National Smart Cities" in 2012, making the smart city a goal for many cities, such as Beijing, Shanghai, Guangzhou and Shenzhen. The aim is to apply various technologies to help solve urban problems, including traffic congestion, health care problems and imbalances in the educational system. However, although current research has promoted the development of smart cities, more methods and theories are required if we are to

generate a comprehensive understanding of cities (Batty 2013) and to lift them to a higher level – the smart stage. As a result, several competitions have been held in the context of the smart city to investigate the application of technology in the urban space.

A competition workshop entitled the "Future of the Smart Island" was held by the Chinese Society for Urban Studies, Spatial Planning and Sustainable Development from 8 Aug to 15 Aug, 2018. The workshop aimed to find new ideas and designs for Huangguan Island that could help transform it into a digital island with low energy consumption and self-sufficiency. The object of this design, Huangguan Island, is on the list of the first group of uninhabited Chinese islands, issued in 2011. The island is as small as a park, measuring approximately 500 meters by 500 meters. During the competition, all participants were requested to live and work on the island so as to better experience it. The participants were encouraged to study, innovate and design independently and spontaneously while considering current natural circumstances and the future development of urban areas. Additionally, generating ideas regarding nature and human construction activities was encouraged, including the future intelligent and digital construction of the island (Fig. 10.1).

Fig. 10.1 Future of nature and technology

This chapter describes one awarded work as a means to discuss how data-augmented design (DAD) can be applied to the process of future-oriented design. The investigation is organized as follows. First, a basic analysis of the site was conducted to generate a design concept. Then, the overall design framework was proposed. In the next step, data analysis was performed to help better understand the site, particularly the island's natural environment. Based on the analysis results, a comprehensive system was designed that represents our vision for the site. A conclusion and discussion of the third type of DAD are presented in the last section.

10.2 Basic Analysis of the Site

10.2.1 Design Site

Huangguan Island is located in the easternmost part of China and is part of the county-level city of Fuqing, Fuzhou City, Fujian Province. Fujian Province, which is located on China's southeastern coast, is adjacent to Zhejiang Province, Jiangxi Province, and Guangdong Province and southeast of the Taiwan Strait and Taiwan Province (Fig. 10.2). Most of Fujian land is covered by continuous mountains, hills, and intersecting valleys and basins, which account for more than 80% of the province's total area. The land coastline is tortuous and eroding, and its total length extends 3,752

kilometers. The intertidal zone has an area of approximately 200,000 hectares, with mud, sediment or sand as the main sediment. Fuzhou City is the capital of Fujian Province. It is the political, cultural and transportation center of Fujian Province and a central city in the economic zone on the west side of the Strait. Fuzhou has a total area of 119,900 square kilometers and a total coastline of 1,137 kilometers, accounting for one-third of the total coastline of Fujian Province. Administered by Fuzhou City, Fuqing City is a county-level city with 212 islands and 61,000 hectares of beach, which indicates the varied topography of the seaside area (Fig. 10.3).

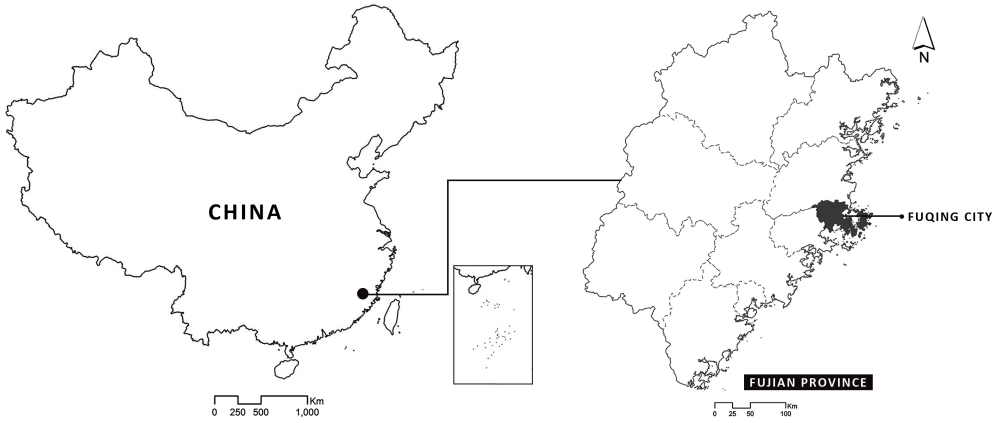

Fig. 10.2 Design site location

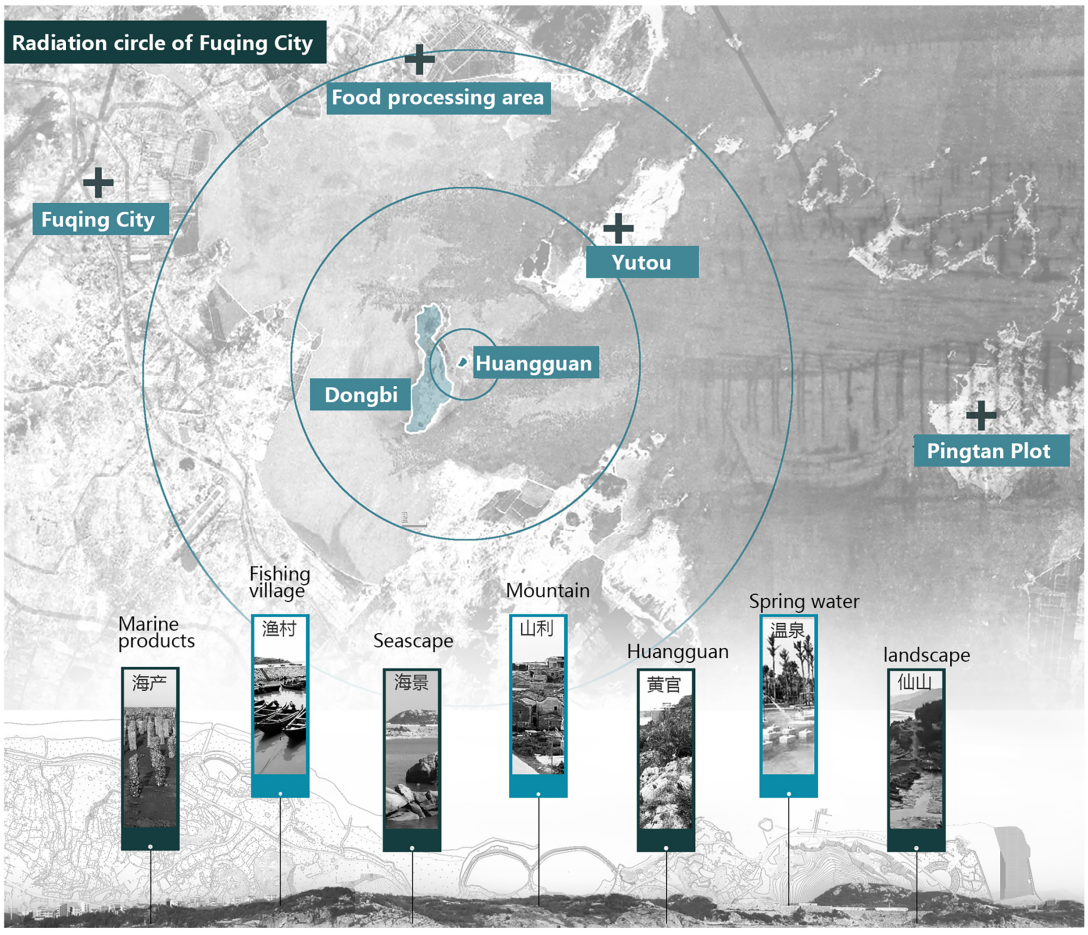

Fig. 10.3 City radiation circle

Close to Huangguan Island, Dongbi Island is east of Fuqing City. Its length from north and south is 3.88 kilometers, and its entire area is 2.64 square kilometers. Dongbi Island Tourist Resort is a coastal tourist resort offering unique characteristics and amusements by integrating leisure, sea sports, folk experience, seaside dining, beach bathing and other functions. However, although Huangguan and Dongbi are only some hundreds of meters distant from one another, there is no ferry between them. If tourists wish to visit the other island, the only option is to hire a small fishing boat or walk across the tidal flat after ebb tide. Overall, the merits of the resources of Dongbi Island have not been fully investigated.

10.2.2 Site Development Site

Because of its location and small area, information on the history of Huangguan Island is limited. However, However, the history of its neighboring island, Dongbi, can be traced to the Ming Dynasty. As noted in the Working Program of the National Strategic Construction of "Fuzhou on the Sea" issued by the local Municipal Party Committee and the Municipal Government, in the course of the development of modern and contemporary China, Huangguan Island and other uninhabited islands were designated for priority development. Subsequently, increasing attention was paid to promoting construction on four such islands in Fuqing. Since 2013, with the support of the local government, a yacht wharf and a wooden trestle road around the island have been completed to complement the existing transportation facilities, and a leisure restaurant, wooden residential villas and other facilities have been constructed (Fig. 10.4). To protect the island's ecological environment, water is not supplied by drilled wells but piped from the nearly mainland. Since the construction of reservoirs on the island, daily water has been supplied from the main island, while electricity is supplied by submarine cables to the uninhabited island. In last ten years, all infrastructure construction on Huangguan Island has been complete. Recently, tourism has become Dongbi Island's primary source of external resources. Most people come to the island for holidays or special events, such as weddings.

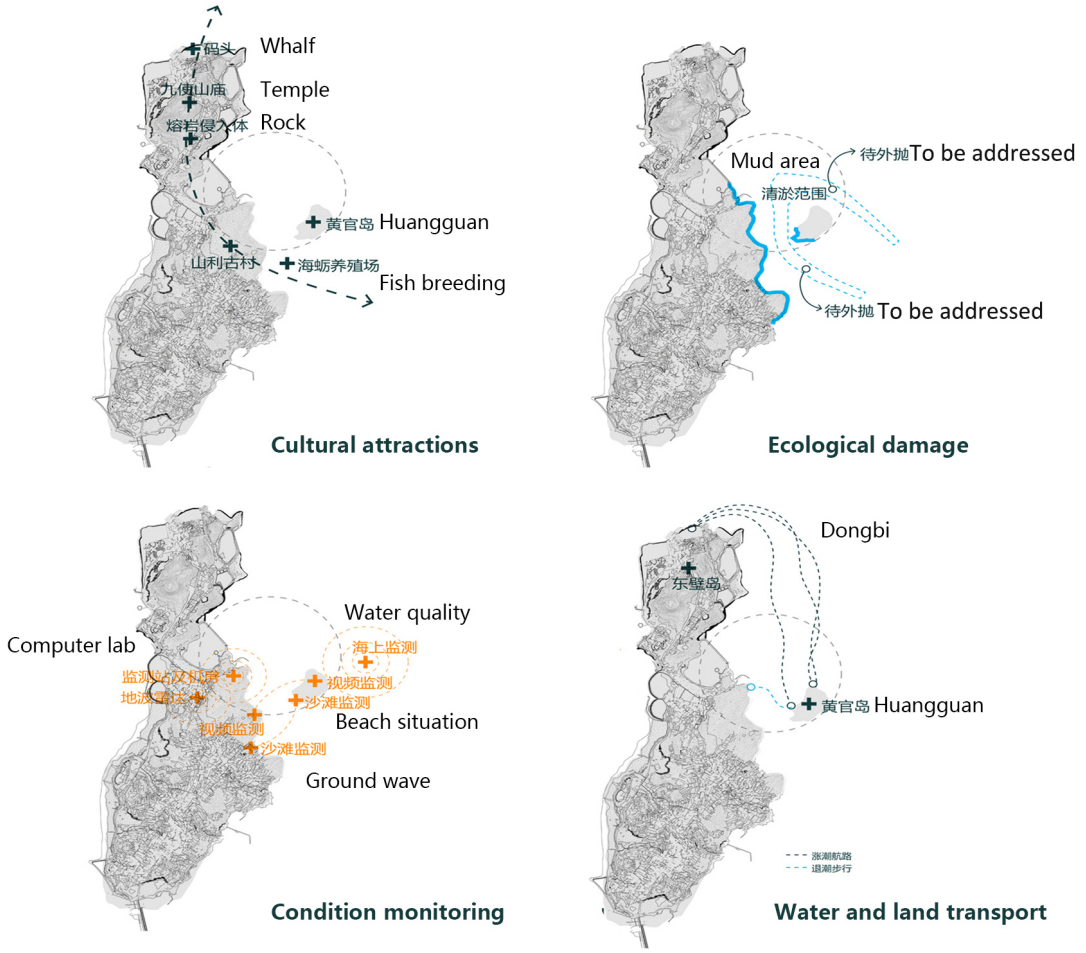

Fig. 10.4 Current situation of Huangguan Island

10.2.3 SWOT Analysis

To better compare the site's advantages and disadvantages, we conducted a strength, weakness, opportunity, and threat (SWOT) analysis to assess the island's resources and to determine the potential and future opportunities based on government policy, resources in the surrounding area and potential undesirable effects. The results indicate that the sparse ecologically friendly environment and rich marine resources of the island make it unique compared to other excessively overdeveloped islands. In addition, the island's location at the center of Fuqing Bay and its close proximity to several ports make it competitive. These observations indicate that the original ecological environment and the special location are vital advantages for Huangguan Island. In contrast, the size and terrain of the island are its primary limiting factors. Most of the island is covered by rocks, which means there is very little usable land. As a result of these constraints, the carrying and reception capacity of the island is limited. The best chance for the future development of the island is governmental support to develop smart islands in Fujian, which would make access to improvements on surrounding islands easier. However, the dilemma would remain of constructing a smart island while maintaining a balance between the new infrastructure and a healthy environment. It is worthwhile considering how to reduce the negative effects of tourism and construction.

10.2.4 Policy Support for Future Development

In 2010, Fujian's government published a new policy named "Digital Fujian", which encourages constructing a digital, networked, visualized and intelligent system to integrate and cope with urban information in Fujian Province, with the goal of constructing a smart city system. This smart and digital system would integrate and utilize all types of information source to the greatest extent through digitalization and computer processing in all fields and would provides diverse information services quickly, completely and conveniently to realize the informatization of the economy and society. The main content of "Digital Fujian" addresses the following aspects: strengthening the information infrastructure; expanding the use of the Internet and improving the public information network; promoting the integration of telecommunications, cable television and computer networks; and finally, realizing the interconnection and interoperability of various information networks to form an information-sharing system covering the entire province. Other aspects of this policy statement include enhancing the development and integration of various information resources, establishing a "Digital Fujian" technical support system, promoting industrialization by information, developing e-government and promoting the construction of a government information system. The development and construction of information application systems represents the key strategy.

In response to this opportunity, local governments are paying substantial attention to the development of all districts in Fujian but particularly to new and coastline areas, which can accommodate more new changes. For Huangguan Island, this is the best time to think about the future.

10.3 Research Framework

10.3.1 Design Concept

The aim of this design consideration is to seek an appropriate way to develop Huangguan Island scientifically and sustainably. Regarding the smart city concept, the design aims to not only satisfy the demand for economical and efficient tourism but also the demand for ecologically friendly environment protection with rational technical support and creative strategies. The most important task is to develop methods to integrate the key factors of nature (i.e., landscape and marine resources) and human needs (i.e., hospitality and tourism experiences) and to enable future techniques to be applied in the design. In our opinion, spatial intervention is not the only way to design the site. In addition, by embracing new technologies, digital innovation represents another, essential way to create a space in a given location in the future (Fig. 10.5). That is, we can strengthen people's experience of nature and their perception of space using various technologies. Although this concept involves a future vision of design, one can nevertheless offer a detailed description and emphasize the approach's substantial potential to realize ambitious ideas.

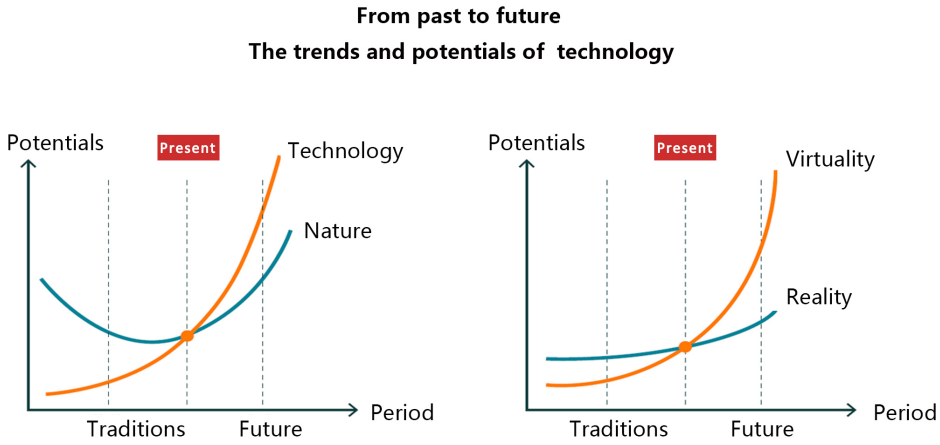

Fig. 10.5 Future vision of design

10.3.1 Design Framework

Adopting the concept of spatial intervention and digital innovation (SIDI), this design is a research-oriented one based on the data-augmented design (DAD) framework (Long and Shen, 2015). According to DAD, which serves as a foundation to help understand the actual site and generate strategies, we proposed a five-step design framework (Fig. 10.6).

First, to depict the site, we collected multiple data, such as geographic urban data for spatial analysis, meteorological data based on Ecotect (software specially designed for analyzing the thermal environment), and image data. These data were analyzed to summarize current circumstances and locate any problems the site may have. Specifically, we used urban data, such as point of interest (POI) data, and road network data for Fuqing City and Changle City to describe the development condition of the site. We also searched for meteorological data in The Chinese Standard Weather Data (CSWD), meteorological parameters, and tidal information data to describe the actual environment. In addition, terrain data, such as contour lines and slope data, were collected, and a 3D model was created as the basis of the design. To better design the site, several case studies were conducted and their results collected as an important data source. Second, we chose several easily operated technologies to speed the process of data analysis and design generation. There are several such accessible tools, including the GIS platform for spatial analysis, sensors for data collection at the site, and artificial intelligence (AI), which were used for data analysis and design. The third step was the main part, in which we applied the data analysis results to generate the design. In this step, which was inspired by several conclusions based on the data analysis, strategies were proposed to enhance the design concept with creative and active thinking about technology application. These detailed designs for location and form are expected to solve specific problems. Based on these strategies, we established a comprehensive system from different perspectives for the design. The design integrates various functions, such as transportation, monitoring, ecological measures and information gathering, as system activities. Finally, we present the future vision of the design using several sketches and scene graphs and explain our concept through specific designs.

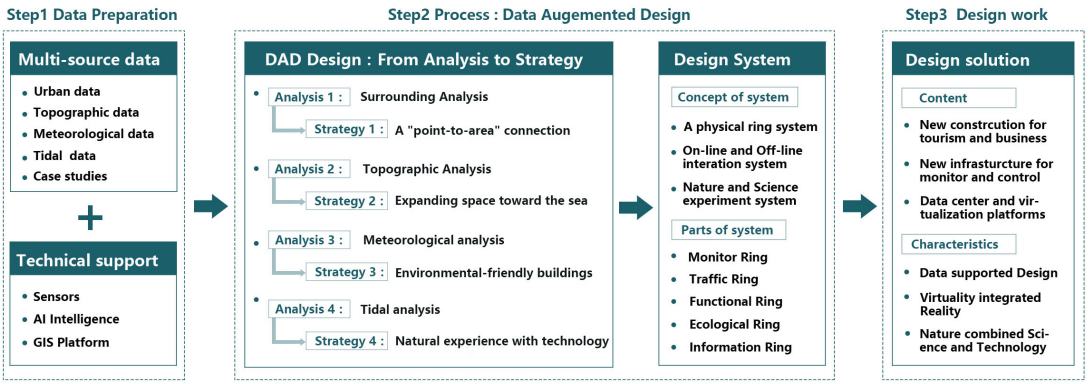

Fig. 10.6 Design framework

10.4 Data Analysis for Understanding the Site

Data analysis, which provided comprehensive information for better understanding the site, is the crucial part of the research-oriented design. Such analysis can provide a solid foundation and rational explanation for underlying design strategies. Instead of making a framework for all fields of quantitative analysis, we focused on several main indicators that could help extract site features and identify prominent problems. However, data collection was difficult in this long-uninhabited location, which limited our research and analysis. Thus, we determined to analyze regional development rather than only the island. Based on the previous SWOT analysis, the natural environment has great potential to make the island better. Therefore, we analyzed the surroundings and several ecological elements, including topography, tide rules and meteorology.

10.4.1 Surrounding Development Analysis

First, we studied possible impacts of urban development and future expansion on the island by analyzing the urban land, activity, the road network, development and construction around Huangguan Island using a GIS platform (Fig. 10.7). Because of the central location of Huangguan Island in Fuqing Bay, we selected the entire area around the bay. The results indicate that with urbanization, the commercial area around Fuqing Bay and in the Pingtan area has been growing in the last five years. Both the density of the urban road network and the urban land-use scale have increased. Regarding Huangguan Island, although it lacks a rich material environment, the island's unique geographical position could facilitate using surrounding resources to help itself broaden its development. Therefore, it was necessary to consider the connection of Huangguan Island with its surrounding areas rather than only focusing on the limited area of the island.

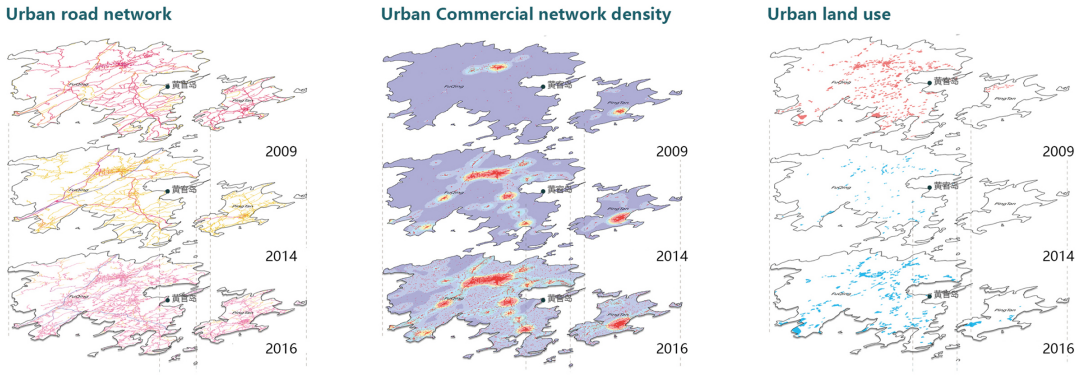

Fig. 10.7 Surroundings Analysis

10.4.2 Topography Analysis

The analysis of the land situation and topography through a GIS model enabled us to understand the natural conditions and construction situation. The GIS model was used to analyze altitude, slope and orientation (Fig. 10.8). The results reveal that the island is covered by rock, and its slope is approximately 10-25 degrees. According to the results, the northwest portion of the island is steeper than the southeast portion and thus not suitable for additional construction, while most areas in the southeast are covered by vegetation and offer a better landscape. These outcomes imply that the area for design and construction on the island is limited.

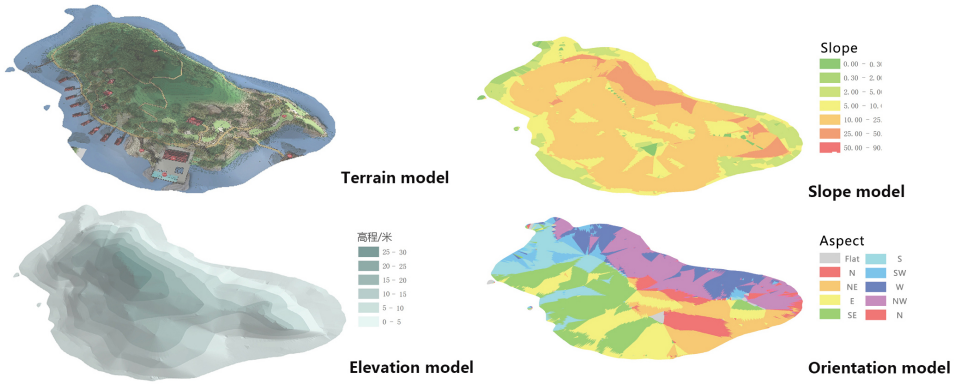

Fig. 10.8 Topography analysis

10.4.3 Tide analysis

Because the island is surrounded by the sea, its landscape typically changes with the daily fluctuation of the tide (Fig. 10.9). According to data obtained from the local weather bureau, we present several graphs to describe the change of the waterline. The graphs indicate that the tide usually starts to rise at approximately 6:00 am and begins to ebb at 6:00 pm. During the day, the water level typically fluctuates between 6 m and 8 m, with highest level usually appearing between approximately 12:00 pm and 12:00 am. Such a spectacular natural tide phenomenon offers a unique opportunity for people to enjoy the charms of nature. In this design, the tide and beach landscape is considered in creating an attractive tourism area.

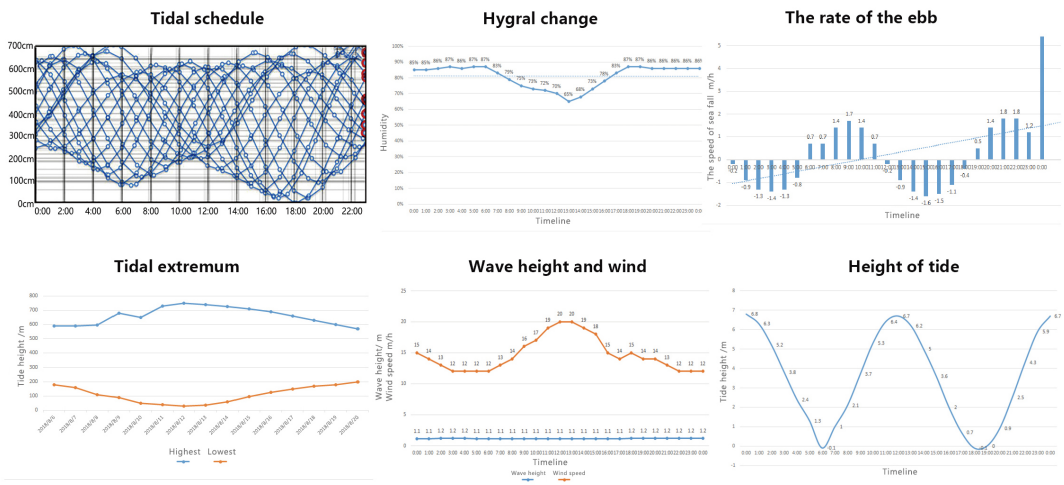

Fig. 10.9 Tide analysis

10.4.4 Meteorology analysis

The purpose of analyzing meteorology and simulating a microenvironment was to seek a harmonious relation between the natural environment and buildings. The analysis of wind speed, temperature, humidity and rainfall in all four seasons can provide a reference for the layout of buildings and their form. As shown in Fig. 10.10, the period from March to October is best for tourism because the overall environment is comfortable. Additionally, computational fluent data (CFD) analysis was applied to analyze the effects of different building layouts under the same wind condition to select the best layout.

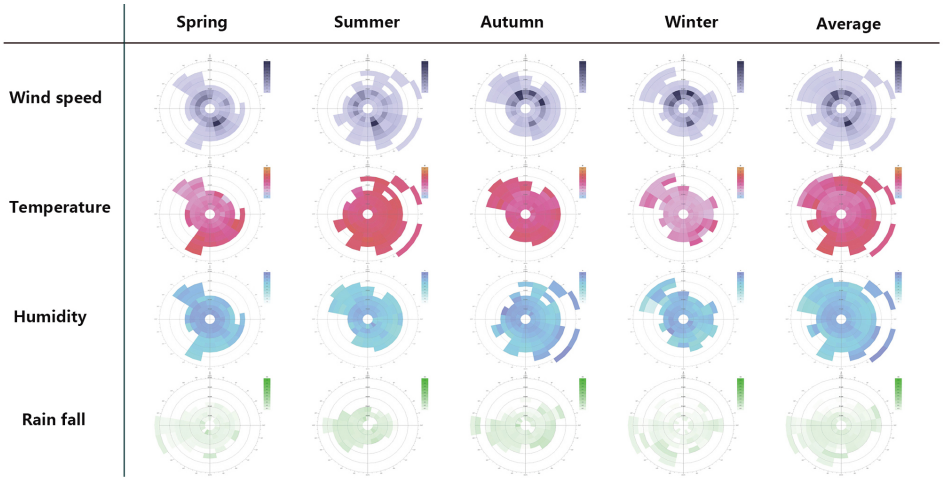

Fig. 10.10 Meteorology analysis

10.5 System Design

The previously described comprehensive analysis of Huangguan Island represents a profile of this small island. However, when speaking of the future, two questions should be considered. What will the island mean to the region in the future, and what will the island look like in future? The first thing that concerns us is the relationship between the city, the island and the sea (Fig. 10.11). In the past, people lived in the city and easily found access to most of its resources, including technological

offerings. However, because of its geographic isolation, few such resources could flow to island. Similarly, the natural landscape and ecological experiences are typically alien to urban residents. It seems that the "city-island-sea" relationship is weak and repulsive. To solve this problem, we aimed to design a carrier to connect the city and the island and bring more activities to the island. This technological carrier, which contains a series of functional systems, is termed the smart "O".

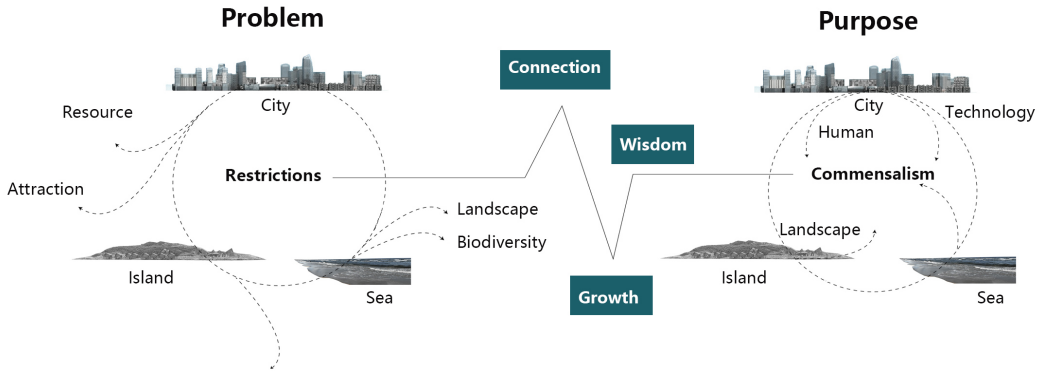

Fig. 10.11 System generation

10.5.1 The Smart "O"

Considering the existing spatial location characteristics, we integrated all types of function in the carrier, which is also a carrier of science-technology-nature interaction and people-public space. We designed a physical ring named the smart "O" to reflect the connection between the former three components, which is coordinated with their distinct morphology and to present the three features of this design: "Obit", "Organic" and "Oasis". "Obit" means linking the island with the bay and city to change the situation of restriction and separation so that they can share resources and maintain a friendly relationship. "Organic" refers to constructing long-term sustainable development, which can be separated into several phrases so that new functions and facilities can be added gradually, decreasing their influence on the environment. "Oasis" contains the meanings of ecology and Utopia and expresses the aim of realizing a poetic habitation. Therefore, the smart "O" refers to employing new technologies and future life concepts in constructing a self-sufficient, environmentally friendly island, i.e., to create a unique future island (Fig. 10.12). In this design, embodying digitalization and technology in spatial design is the key point. Several strategies based on "connection", "growth" and "ecology" were developed to meet human demands and contribute to realizing a symbiosis between city and island as well as between human and nature.

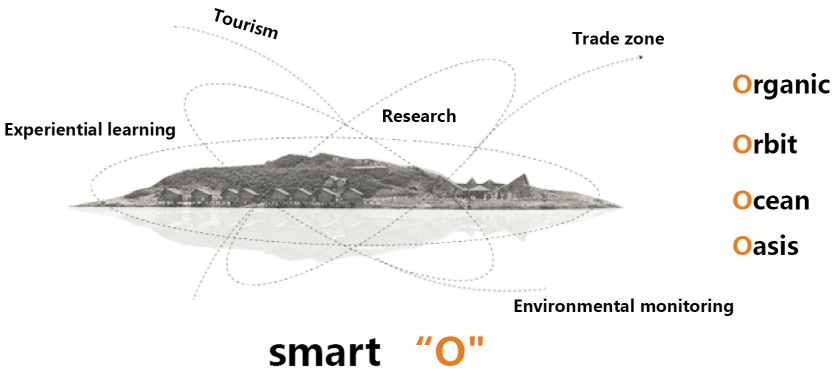

Fig. 10.12 Meaning of the smart 'O'

10.5.2 Main Strategies

There are four main strategies that correspond to the core concept and the island's current problems: constructing a "point-to-area" connection, expanding the space toward the sea, coordinating buildings with their microenvironments, and embracing technology to augment reality. Aiming at solving the problem embodied in the analysis of the surrounding area, the first strategy is to solve the developmental problem on the city level. The second strategy addresses the land use problem and extends construction to the sea level. The third strategy considers the microenvironment and how to coordinate buildings with it, while the last strategy involves employing reality-augmentation technology to intensify the experience of nature.

(1) Strategy 1: Constructing a "point-to-area" connection

In view of the advantage of location, a connection strategy termed "point-to-area" was adopted to strengthen the connection between the island and the city by sharing culture, ecology and resources and to assess the island's potential as the geographical center of Fuqing Bay based on lengthening the important loop to Fuqing City and Fuzhou City.

(2) Strategy 2: Expanding the space toward the sea

The extension strategy aims at expanding the island's available area, locating new construction in the seaside space and joining it with island by the "O" ring to accommodate more functions. Considering the island's sustainable development in the future, the time dimension is considered. The construction condition is not static and can be adjusted according to actual use (Fig. 10.13).

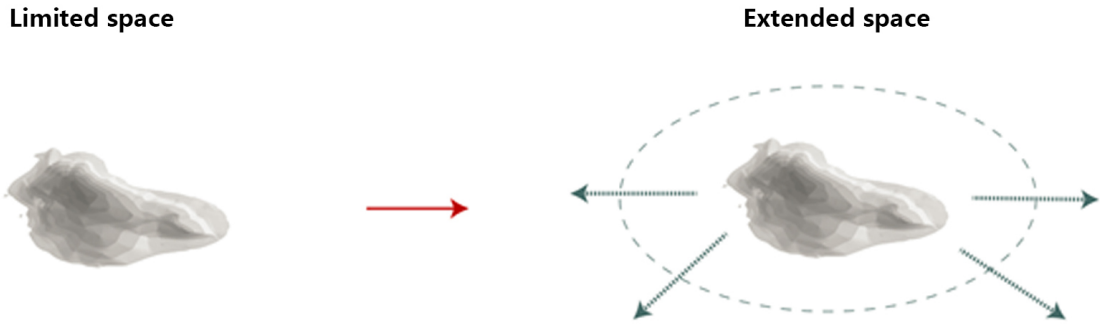

Fig. 10.13 Extension of the space

(3) Strategy 3: Coordinating buildings with the microenvironment

To create a more comfortable microenvironment, the environmental performance of various building layouts was simulated. As shown in Fig. 10.13, the courtyard-style building layout achieved better microenvironment simulation results (Fig. 10.14).

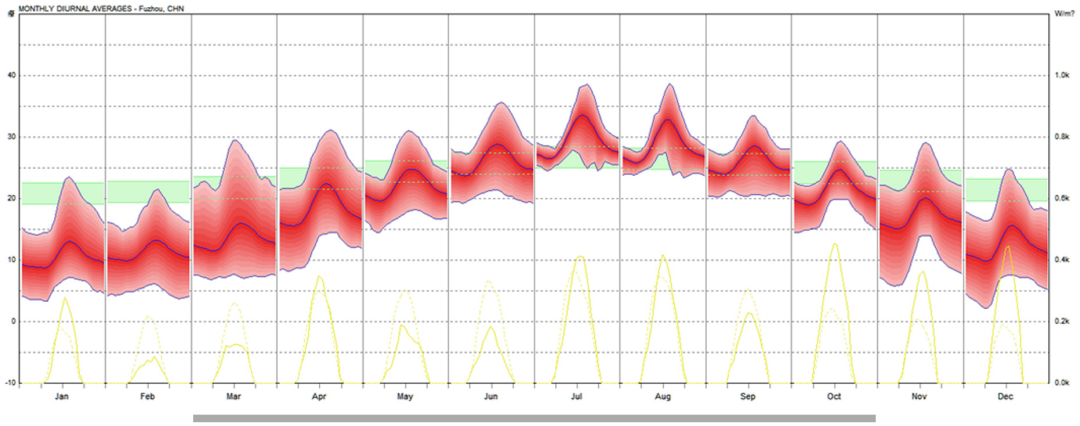

Fig. 10.14 Micro-environment simulation

(4) Strategy 4: Embracing new technologies to enhance the experience of nature

In view of the island's abundant landscape resources, the scenery near the beach represents a precious resource for experiencing closeness to nature. In this design, we attempt to make use of the change in tidal scenery over time and combine it with virtual reality technology to enhance the experience of reality and nature (Fig. 10.15).

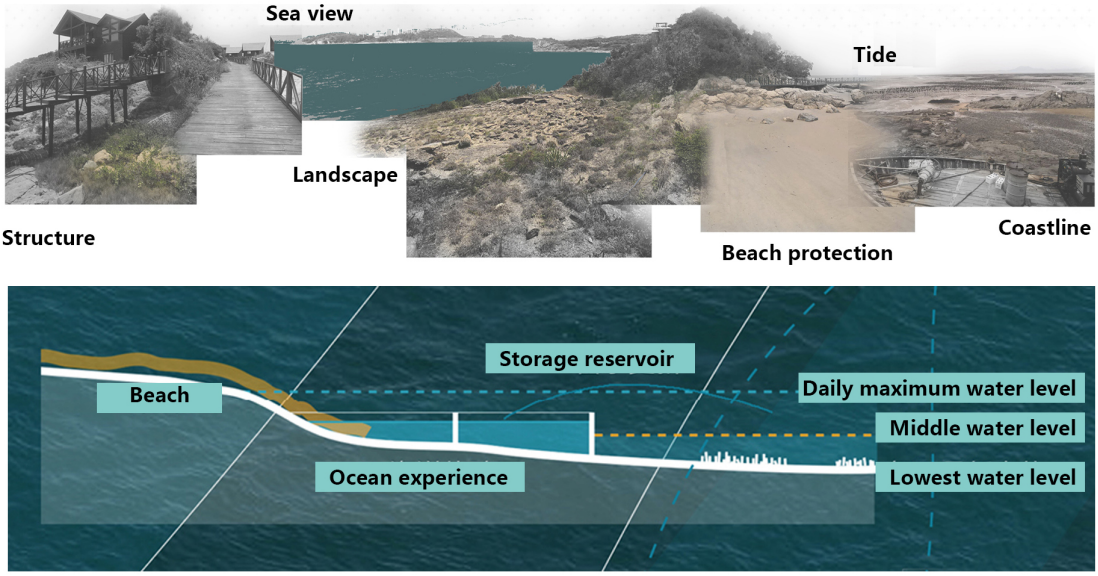

Fig. 10.15 Natural experience and ecology protection

10.5.3 Comprehensive System

Based on the described strategies, more detailed design aspects of the comprehensive system are discussed to clarify the design concept and realize the final version. The entire system is designed to address the traffic stream, functional distribution, the ecological experience and information control. Therefore, four subsystems are involved: the traffic ring, the ecological ring, the functional ring and the information ring.

(1) System 1: Traffic Ring

The first function of the "O" ring is to organize traffic (Fig. 10.16). There will be a circular track on

the surface of the "O" ring that will accommodate waterbuses and sightseeing trains. The "O" ring will also provide abundant paved walkways and bicycle paths for pedestrians and riders. As the main bridge between Huangguan Island and Dongbi Island, the ring will become the main way to enter Huangguan Island, supporting local delivery transportation and daily commuting (Fig. 10.17).

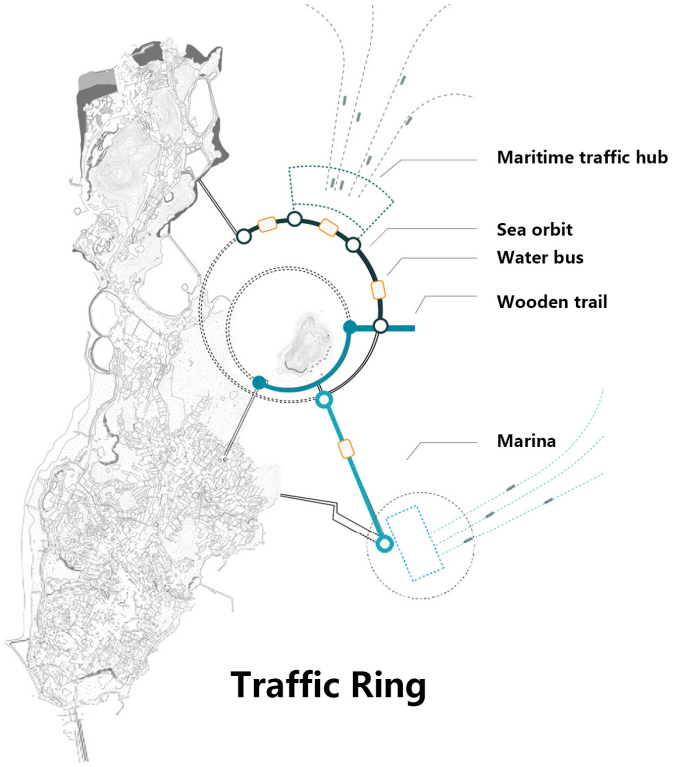

Fig. 10.16 Traffic ring system

Fig. 10.17 Sea orbit and waterbus in the traffic ring

As shown in Fig. 10.18, two paths can be chosen: the ecological and technological experience route or the business and holiday experience route. The first route features a walking path in the tidal zone and access to a water experience, while the other leads people into the business and entertainment experience zones. In addition, there will be a port on the "O" ring with a waterbus wharf in the north and a yacht marina in the south.

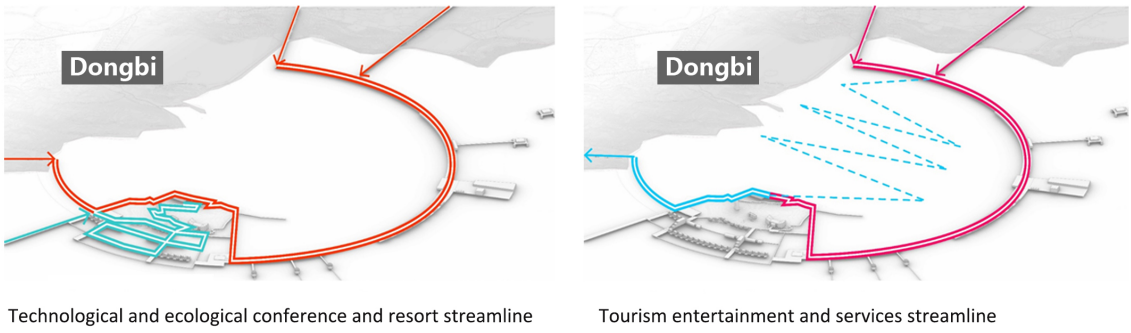

Fig. 10.18 Two streamline types

(2) System 2: Ecological Ring

An important function of the "O" ring is to provide a means for tourists to experience the island's natural environment (Fig. 10.19). When people pass through the "O" ring, they enter experience areas with different natural landscapes. The first is the beach experience area, where people can undergo an immersive experience when walking along the walkway. The second is the marine agriculture zone, where people can observe floating agriculture and view the industrial technological innovation of the island. The third is the waterscape park, formed by the ring's boundary. When the tide rises, the waterscape park is full of seawater. While with the tide ebbs, the water level falls, and the tide flat appears. However, the waterscape park will continue to store water, which makes it a public node and the entrance to the business zone. After the park, people come to the fishery experience area, where they can follow local residents to participate in harvest activity after the tide falls. The last part of the ring is the beach restoration zone, which is maintained and protected as an experimental natural restoration area. These five main landmarks will help people enjoy the scenery and enjoy a rich experience as they walk along the ring.

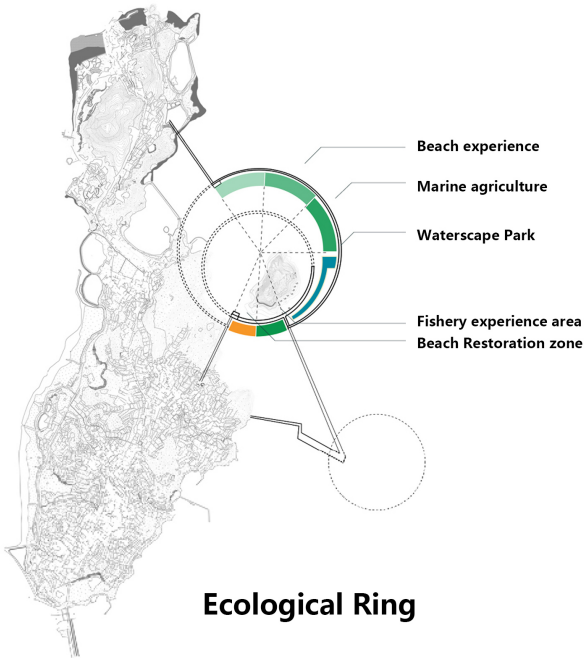

Fig. 10.19 Ecological ring system

(3) System 3: Functional Ring

Another important purpose of the "O" ring is to integrate more in-demand functions to complement the island's development (Fig. 10.20). Because of the island's limited construction area, new functions will be added on the "O" ring, integrated with the streamlines. To satisfy varying visitor needs, several meeting rooms, recreational facilities and accommodations will be constructed on the eastern part of the island based on original service facilities. There are also several reserved sections and abundant space on the ring to develop and add new functions in the future (Fig. 10.21).

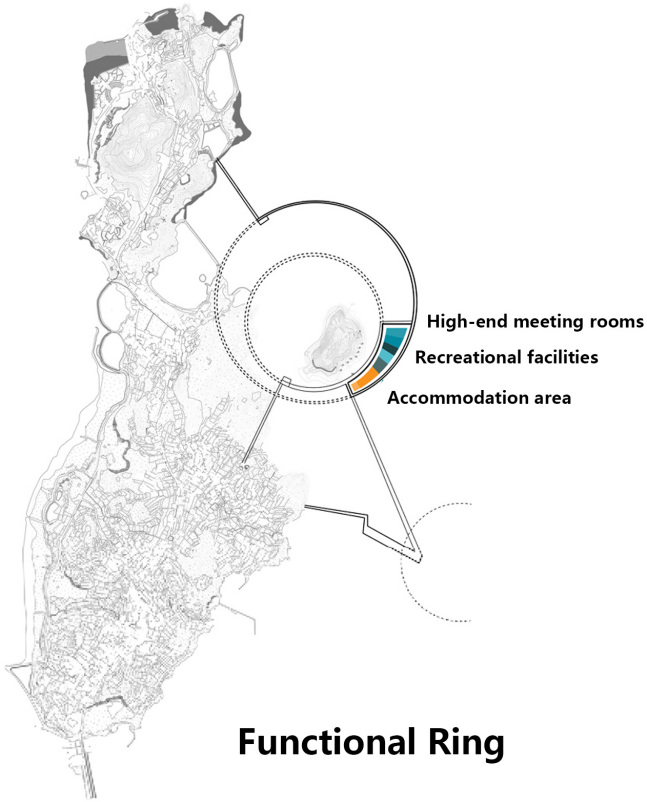

Fig. 10.20 Functional ring system

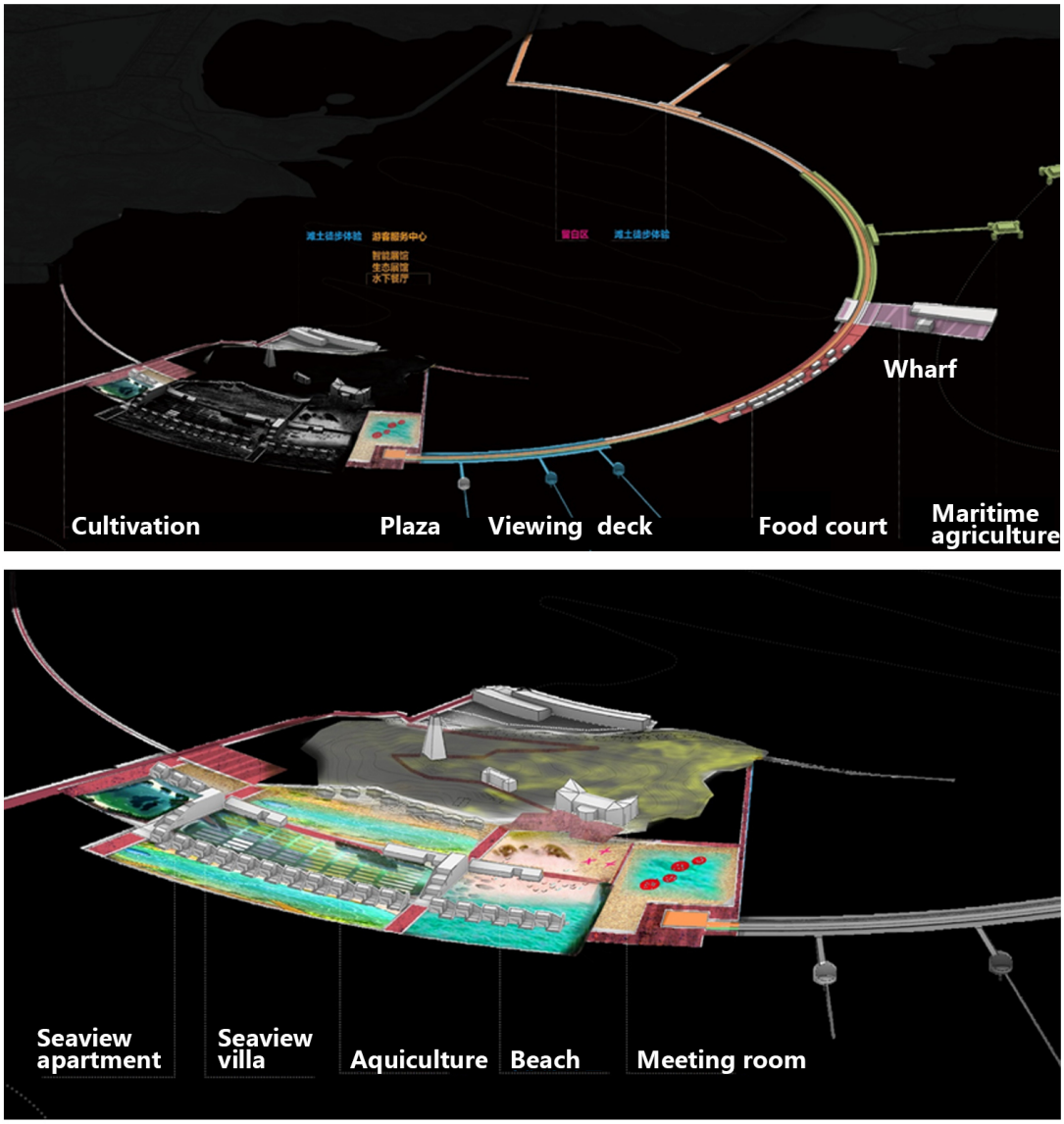

Fig. 10.21 Functions to Be Added in the future

(4) System 4: Monitor Ring

In the design, intelligent facilities (such as sensors) are added to the material ring to monitor and record the quality of and changes in the marine environment. Thus, the "O" ring also behaves as a sea-monitoring center (Fig. 10.22). For example, there are several extensions of various lengths reaching into the sea on which sensing devices are installed to detect floating objects (Fig. 10.23). When these sensors detect a floating object, the center is notified and marine robots dispatched to pick up the objects. If anyone is found in an emergency or danger, an alarm will be issued, and a rescue immediately carried out.

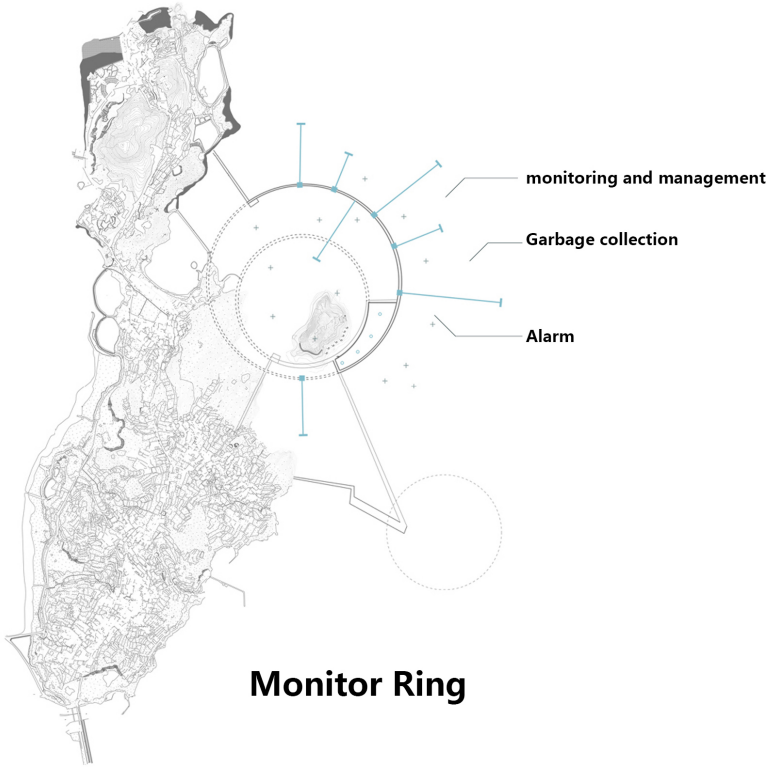

Fig. 10.22 Monitor ring system

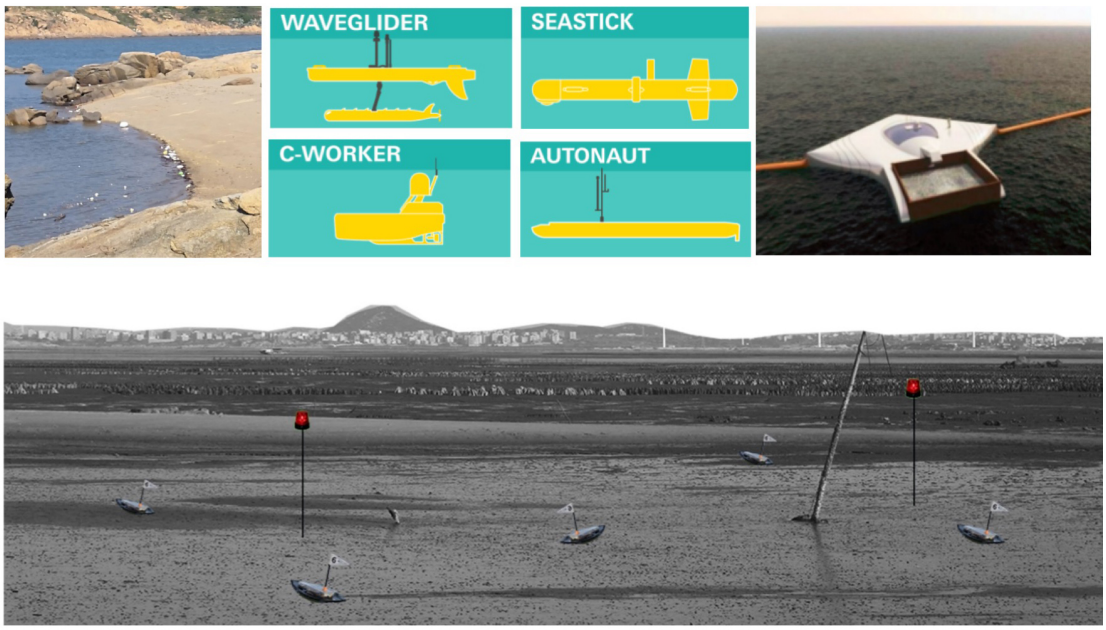

Fig. 10.23 Monitoring the condition of sea

System 5: Information Ring

The last function of the "O" ring is to collect data generated by tourists and the environment, and thus, it is referred to as the "information ring" (Fig. 10. 24). The core part of the ring is an information-processing center that controls various smart facilities. Certain smart facilities, such as smart lights, can be installed at fixed positions on the ring to collect information. For example, smart

lights can automatically coordinate their brightness according to the human flow and the real-time electricity use. Smart trash bins can identify trash types, sort them automatically and break them down intelligently. In addition, individuals can obtain real-time monitoring information through applications on their personal smartphones (Fig. 10.25). Moreover, information regarding bicycle or meeting room availability, show times, and festival events can be searched on the APP service. Accordingly, tourists can make reservations and arrange their itineraries in advance (Fig. 10.26).

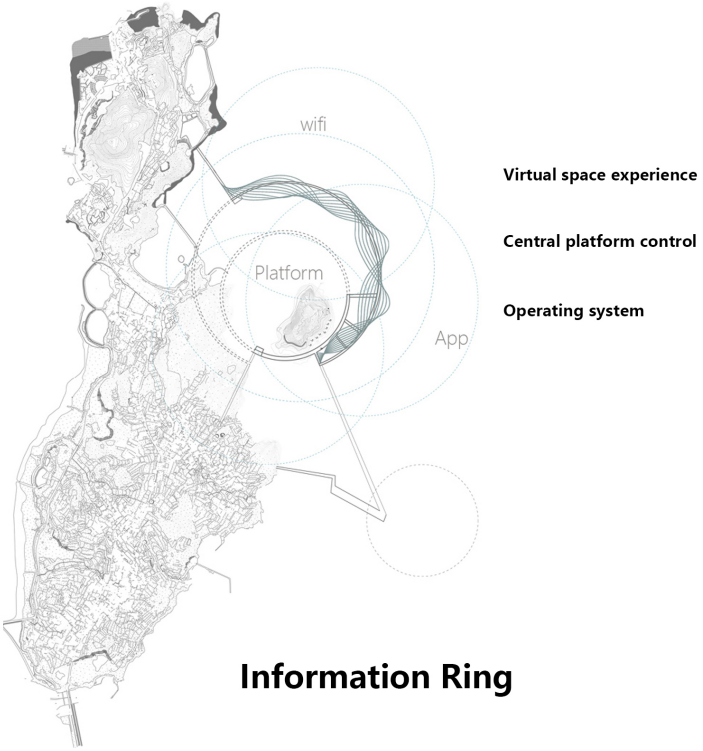

Fig. 10.24 Information ring system

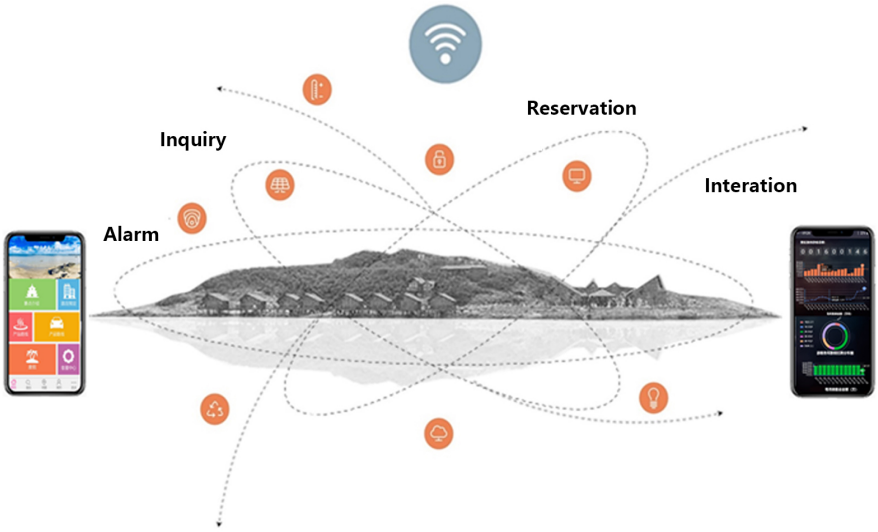

Fig. 10.25 Private operation system based on the information system

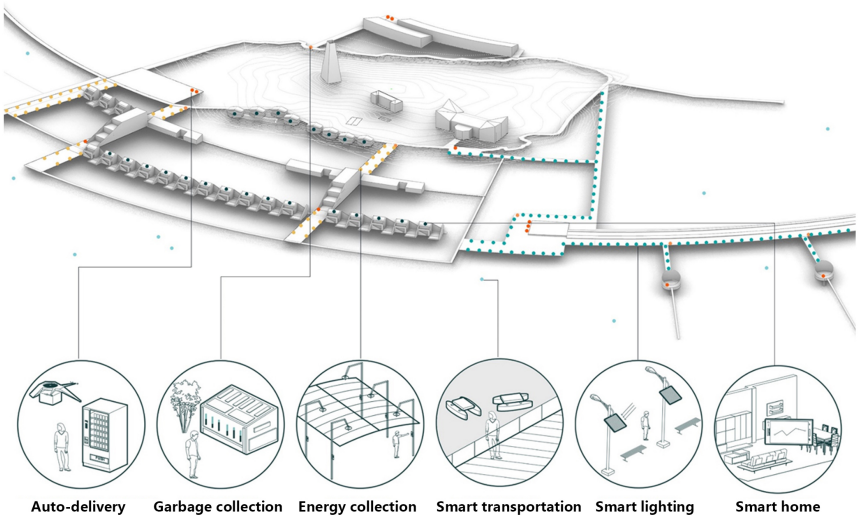

Fig. 10.26 Smart system for smart facilities

10.6 Augmenting Nature with Science and Technology

Traditionally, the interaction between nature and the built environment is primarily confined to visual experience, which always maintains distance, and thus full sensory stimulation is lacking. However, in the future, with the help of new technologies, there will be different ways to explore interaction between the natural and built environments (Fig. 10.27). In this design, a more interesting and friendly way is introduced to bring people close to nature through technology and online interaction. First, there is a digital system that supports smart interaction. The entire system consists of a two-part agent. One part is the physical participants, such as people, devices and the physical environment. The other is the virtual online surroundings, such as a database and a mobile phone application. In this way, people can check and evaluate information regarding nature, such as the weather, the identity of plants and the sea level, and they can also experience virtual scenery through VR technology.

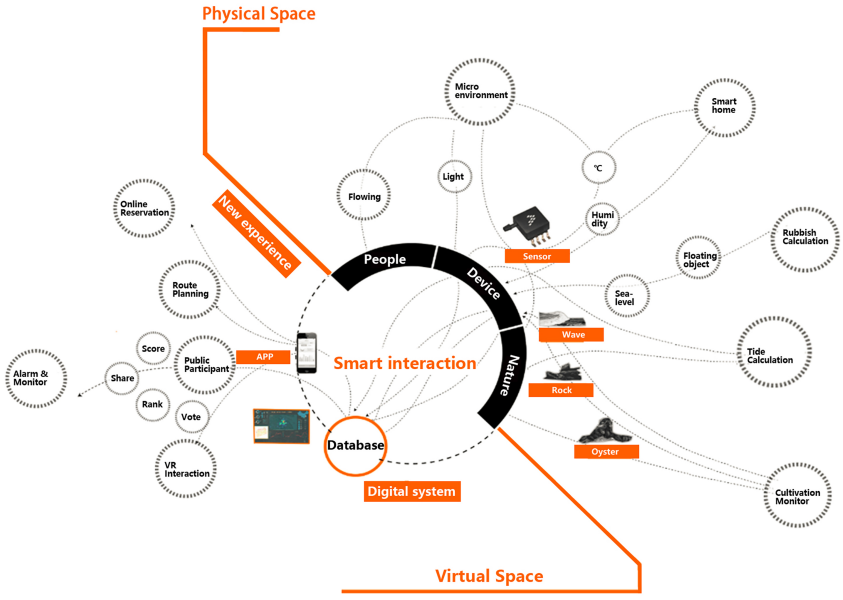

Fig. 10.27 Smart technologies applied to enhance the interaction between physical and virtual space

We use two examples to illustrate the idea of employing technology to enhance the environment. For instance, in an ebb experience scenario, when the ebb falls, the tidal flat appears, and the smart runway and monitor starts to function, whereby the monitor forecasts the time of the tide rising and sends feedback to visitors through a phone message, helping them plan a route. At the same time, the monitor distributes air from the flat level to simulate the condition of streams, changing the height of the air supply outlet to simulate the elevation of the water surface. Thus, whenever someone arrives at a new spot, he or she can sense the water's height in the rising-tide condition. In this way, people can personally experience the pleasure provided by the environment. Additionally, people can wear VR glasses to experience a virtual underwater world, where they can play with marine animals and learn about their living conditions (Fig. 10.28).

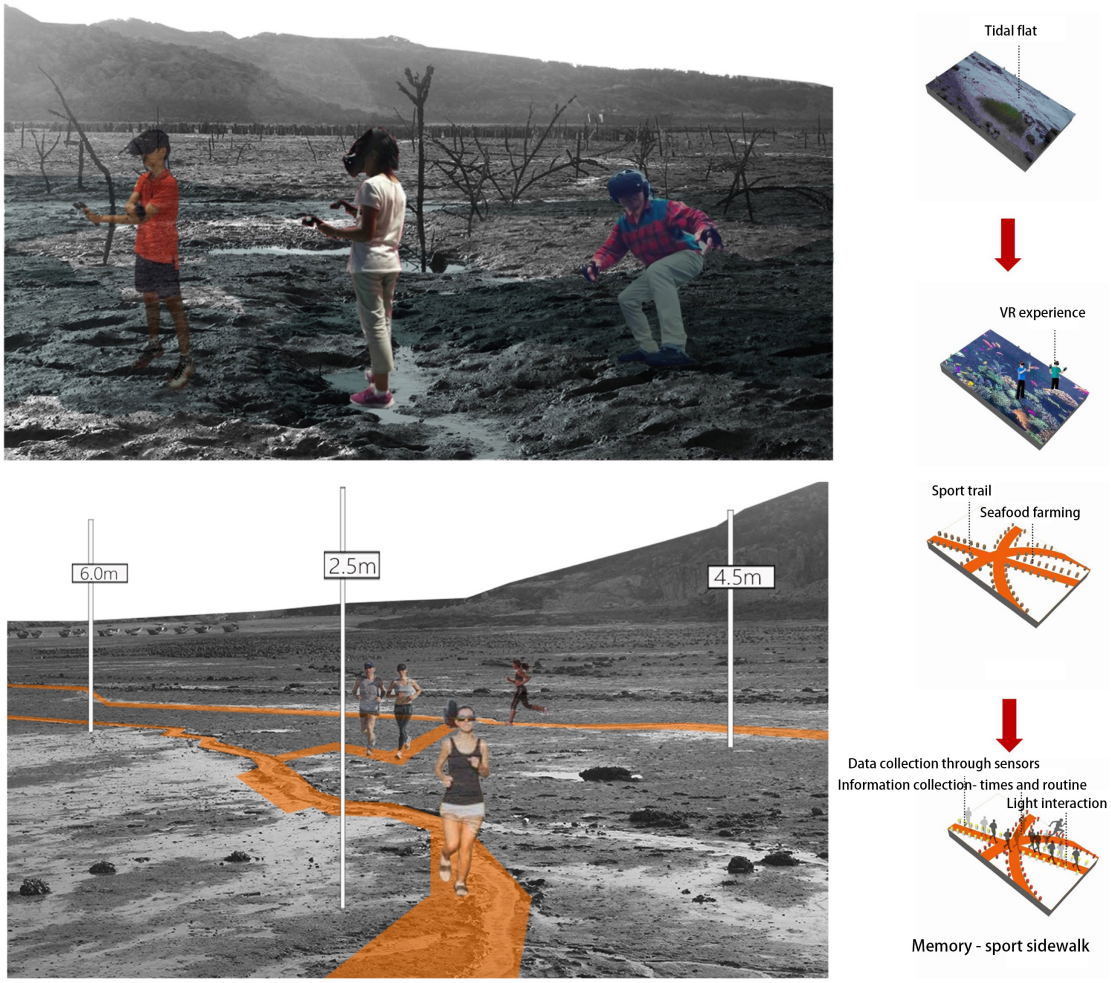

Fig. 10.28 New experience of nature with VR glasses

The other example involves enhancing the experience of sea farming with technology. The oyster industry is a feature of local farming. When the tide falls, the oysters are exposed. Viewed from the shore, the oyster-farming scene is spectacular. In this design, we use lighting design to emphasize the scene. For each cluster of oysters, lighting and a sensor will be installed to monitor the degree of its grade of maturity. The lighting color will change according to the period of the oyster's life cycle. During the night, there will be a light show on the tide, and it will be fun to distinguish different colors and various clusters of oysters. Such light scenery will also change as time passes. This special

scene is also an icon of the island and reflects the concept of combining technology and nature (Fig. 10.29).

Fig. 10.29 New experience of light scenery simulating oyster clusters

10.7 Conclusion and Discussion

This research-based design combines the DAD method with future-oriented thinking about the island. Three aspects are considered in the design: data-based design, virtual-based reality, and natural-based technology. Specifically, we use quantitative analysis to objectively evaluate the current conditions and problems of the design site. This approach provides a basis for the generation of design strategies and helps achieve a scientific and rational design. In the design process, we integrate digital innovation and a traditional spatial intervention strategy. We fully embrace new technologies and apply them in various scenarios. New facilities and technologies are used to create new activities and to enhance the experience of the real world. As a result, a combination of "online and offline" and "virtual experience and real activities" is realized. Because Huangguan Island is known for its natural environment, we adopt strategies to protect that environment and enhance the "sense of nature" by using technology (Fig. 10.30). These three aspects represent the core of the design, which also reflects the main concept of the third type of DAD.

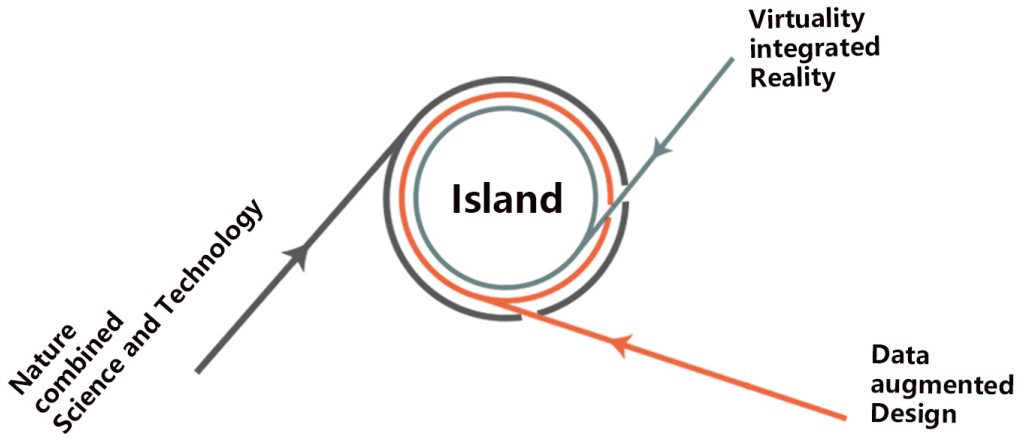

Fig. 10.30 Three main aspects considered in this design

However, certain limitations to the design remain. First, the research was limited by the restricted data. Thus, the circumstances of the island are not fully described, which may cause bias in the judgments applied in the design. In addition, the study uses only two examples to describe the application of the design concept in detailed scenarios. More scenarios involving more technologies must be investigated. Finally, the relationship between nature, the built environment and the digital system should be discussed in greater detail.

References

[1] Batty, M. (2013). Urban informatics and big data. *A Report to the ESRC Cities Expert Group*. October 19, 2013.

[2] Long, Y., & Shen, Y. (2015). Data Augmented Design: Urban Planning and Design in the New Data Environment. *Shanghai Urban Planning Review*, (02): 81-87 (in Chinese with English abstract).

[3] Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G., & Scorrano, F. (2014). Current trends in smart city initiatives: some stylised facts. *Cities*, 38: 25-36.

[4] Dameri, R. (2013). Searching for smart city definition: a comprehensive proposal. *International Journal of Computers & Technology*, 11(5): 2544-2551.

[5] The Ministry of Housing and Urban-Rural Development. Notice on the Pilot Work of National Smart Cities. 2012-12-05 [2019-12-29], http://www.gov.cn/zwgk/2012-12/05/content_2282674.htm.