"City yuan universe": yuan universe enables future urban design

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Abstract: To sort out the key characteristics of the emergence and development of meta-universe, point out the commonalities between meta-universe and urban design: derived from vision, based on reality and collaborative creation; further summarize the three dimensions of meta-universe enabling urban design: space expansion, time continuity and people build. According to the needs of urban construction and operation and the development of urban design work, the method of combining "R (reality)" with "AR (augmented realty)" —— "RAR (reality auqmented reality)" is proposed, and the urban design process and results of meta-universe enabled by "RAR" method are collectively called "city yuan-universe". The typical practice of "urban universe" is summarized, the creation process is classified and refined, the general flow chart of creation and operation is structured, and the technical path of applying "RAR" method to realize urban universe enabling urban design is detailed, in order to provide guidance for the future development of urban design under the background of stock.

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With the development of Internet 3.0, Industry 4.0 and Society 5.0, metaverse has become a major topic in both academic and industrial fields. As a positive imagination of human beings to the ultimate form of the future society, the relationship between the virtual and real world discussed by the meta-universe will inevitably affect the future urban development. In the city, how to intervene to promote the urban development, whether it

can empower the process of urban creation and construction, how to apply the metauniverse concept and related technologies to carry out practical work, a series of subsequent problems need to be discussed. In this context, this paper focuses on the development characteristics of meta-universe, focuses on the meta-universe and urban design, points out the commonness of meta-universe and urban design, and further puts forward three dimensions of metacuniverse-enabled urban design. In fully considering the Fuzhou, Taizhou, explore the experience of this paper puts forward the urban entity space "R (reality)" and "represented by" AR (augmentedreality) "as the technology of the combination of" RAR (reality augmentedreality) "method, detailed the application of" RAR "to carry out the practice of" city yuan universe " the technology path, in order to open the new ideas for urban design work, stimulate urban new vitality.

The 1-yuan universe and urban design

1.1 Characteristics of the emergence and development of the metadimensional universe

From the natural material world to the multi-dimensional world created by human beings, the evolution of civilization has now entered a new era of the digital world [1]. As an emerging concept integrating a new generation of digital technology, "meta-universe" has rapidly flooded all fields of urban social development since 2021, and has been the focus of wide attention in the academic circle and industry [2-5]. However, there has been no consensus on the concept of "meta-universe", Presents the trend of "a hundred schools of thought contend" [6-7], [8-9] The concept of "meta-universe" was first born in 1992 published science fiction work Snow Crash[10], Is defined as a virtual world in parallel to the real world, Concept has strong spatial properties at the beginning of its conception, In the subsequent emergence of literature, art, and games, It basically continues the concept of a "virtual parallel world", And the "open world sandbox game" is the most typical [11].

Although the industrial practice of meta-universe is obviously faster than and more frequent than the academic discussion [12], with the deepening of application scenarios, the academic discussion around "meta-universe" gradually increases with the industrial practice, and gradually expands from the exploration of specific technologies to the definition of the overall world view and the exploration of value connotation. At present, the academic discussion on the theory of "meta-universe" mainly focuses on two aspects (Figure 1): (1) the meta-universe from the relationship between the virtual world and real world and space [2-3,11,15-16]; (2) the meta-universe from the perspective of technical realization [2.12,15]. Zhang Hui et al. [12] believe that the meta-universe is a digital pattern constructed by digital technology. The digital virtual world and the real world can coexist and coexist to a certain extent. Irshad et al. [13] proposed metacopulological concepts based on five key structures, namely metacopulology itself, human / avatar, metacopulological technical capabilities, behavior and results. From the perspective of technical realization of [2], the development path of the universe of space is divided into three categories: replica reality, detached reality and augmented reality. Chen Linsheng et al. [14] built a "technology-economic mutual plastic system" model of the universe to make the universe better integrated with the real economy and industry.

Originating from the discussion of the relationship between virtual and real and the realization of the development of emerging digital technology, in the digital age, the theoretical concept of "meta-universe" will have a broader application scenario. As a

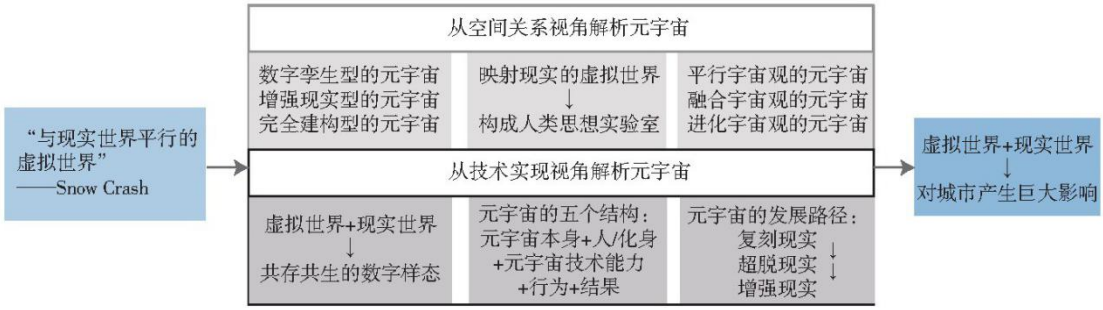
theoretical concept with strong spatial properties at the beginning of its birth, "meta-universe" tries to describe the relationship between "virtual space" and "real space" [2-5], which is destined to have a huge impact on the largest space of human existence —— city [4]. After the initial "explosion" and "hot discussion", to "questioning" and "criticism", when the concept of the universe gradually "cooling", facing the future urban development, this concept and related technology should be fundamentally discussed and application-oriented practical exploration.

The commonality of the 1.2-yuan universe and urban design

1.2.1 Vision: the essential characteristics of meta-universe and urban design

Since 2021, "the first year" of the universe, the yuan universe and urban discussion gradually increased, mainly focus on two aspects: on the one hand is the analysis, the concept of "universe" concept and framework of [5], the development of social space change [6], on the other hand is the application scenario, more typical such as digital city design [15] "universe" planning deal with [4], digital outdoor space [16], etc. Ren Bing [5] will combine the universe and urban space of the latest form named "urban yuan universe (Metaci, and its interpretation for new wisdom city after relay digital twin city and advanced form, is" using block chain technology, interactive technology, electronic game technology, artificial intelligence technology, network and cloud computing technology, iot technology and so on six big technology in the virtual space to build physical urban space, with the perspective of several wisdom civilization construct the future of new ecological city ". The definition from the technology application level more clearly illustrates the concept of "urban yuan universe", has certain reference significance, but unfortunately, the definition from the perspective of practical application, not yet involving "yuan universe" origin relationship, for the construction of "urban yuan universe" theory concept is not detailed, this also comes from the yuan universe"The discussion of the concept itself has not yet been settled

Fig. 1 The development process of the concept of the metacosmic universe



There is no denying that, Both at the technical and conceptual level, The discussion of the meta-universe admits that it "originates from the construction of an imaginary scene." This coincides with the starting point of urban renewal and design in the urban planning discipline; The design and creation of cities comes from the common beautiful vision of mankind [17-20], Realize the description of the vision in the urban space through the professional path; The concept of "meta-universe" serves as a positive human imagination of the future social form [8, 10], Based on the discussion of the relationship between virtual and real, and the realization of [2] based on the development of emerging digital technologies, Is a vision of extending from physical space to virtual space, Both have essential characteristics,

This is also the premise that the meta-universe can intervene in urban design. The future-oriented urban design [22], the concept of meta-universe provides a new way to realize the vision of urban design. The development of "meta-universe" will definitely promote the close integration of urban virtual and real space into [23].

1.2.2 Based on reality: the construction basis of meta-universe and urban design

As mentioned above, the concept of meta-universe has a strong spatial attribute at the beginning of its gestation, and the essence of its application lies in the scene creation for the implementation objects. In the application level, the development trend of "to the virtual" is [2-6] consensus on the current stage of development, "yuan universe" will promote the development of the virtual world close integration, inseparable "virtual integration" [3], this also further illustrates the yuan universe concept and related technology cannot leave the physical space and urban space itself. The design work of urban design as the research object must be carried out [18-19] based on reality, so the meta-universe has the same construction basis as urban design, which is also the basis for the meta-universe to intervene in urban design. Under the huge real space of the city, the involvement of the yuan universe in the traditional urban design work will promote the deep integration of "virtual and real space", promote the development of urban physical space with "virtual", and effectively empower the urban design work. The author calls this process and result "city yuan universe".

1.2.3 Collaborative creation: the realization path of meta-universe and urban design

As mentioned in 1.2.1, both meta-universe and urban design originate from the common vision, which means that in the process of realization, coordination is needed to coordinate the relationship between all parties and stakeholders, so as to realize the description of the common vision in a collaborative way. As a new digital-like [12], in the context of its development and construction, it not only relies on the innovation ability of technology developers, but also needs the collaborative participation of users and content creators in —— interaction and feedback [22-23]. Similarly, the people-oriented contemporary urban planning and design needs the government. Developers, citizens and other stakeholders participate in [19]. In the meta-universe, through interactive experience, users can directly influence and shape the virtual environment and interact with real space feedback [20,23]. This is similar to the communication and coordination of multiple subjects, [24] in urban design, and the general path [25-26] where the public participates in the design through relevant platforms. Therefore, "co-creation" is the common realization path of the meta-universe and the urban design, which is the implementation condition that the meta-universe can intervene in the urban design process.

The 2-dimensional universe enables the three dimensions of urban design

The commonness of meta-universe and urban design provides a complete possibility for meta-universe to intervene and empower urban design. In the digital new era [27], the meta-universe enabling urban design needs to be the implementation dimension to create the "city-enabled universe". Exploring how the meta-universe specifically intervenes in urban design and enables it is an important issue to be discussed in the current context. This section discusses the three dimensions of metauniverse-enabled urban design in detail.

2.1 Space dimension: from reality to virtual

The discussion of the virtual and real space relationship is a fundamental inspiration for the current urban design related work, which is fundamentally brought about by the relevant

technical development under the concept of the metaverse. The "augmented" reality based on AR (augmented reality) and further mixed reality (MR) and more comprehensive extended reality (XR) are an important entrance [2] to promote the construction of virtual and real interactive scenes; At the same time, in recent years, the space computing technology change represented by mobile augmented reality (mobile augmented reality, MAR) technology has spawned more and more urban scale meta-universe application cases, making researchers! Focus on the citys digital space assets. Mobile augmented reality is a kind of AR interactive idea [13] based on mobile devices, due to the improvement of industrial production capacity and the development of computer graphics and human-computer interaction technology. Mobile augmented reality can depict real-time free movement of virtual materials, while keeping the real objects and the ideal spatial relationship between virtual objects, thus effectively support the digital content in urban space into [14], this for the shaping of urban space, from reality to virtual dimension provides the implementation, is the universe brings to the fundamental inspiration of urban design,

2.2 Time continuation: from the past to the future

Due to the more immersive "virtual presence" provided by digital technology, the "meta-universe" provides the possibility to easily travel through time [23]. Looking at the present in the past and seeing the future in the present is the macro scope of urban design in time and space. Based on the dynamic programming theory, Design is no longer satisfied with a single blueprint result, System planning theory, continuity planning theory, action planning model and so on, Planning becomes an active and concrete tool for urban improvement [28-29], The "meta-universe" built by teaching word technology enables the design scheme to be quickly mapped to the site, The content of the "metauniverse" can change quickly and respond, This feature also allows multi-timeline design narrative content to quickly alternate and dialogue in urban space, Breaking through the traditional design and construction cycle, Let the past, present and future can be rapidly associated with urban space [30-31].

2.3 People to build together: from individuals to groups

The intervention of the "meta-universe" provides a sustainable and open opportunity for the people to co-create it. City is the city [27] of human beings, so the practice of "city yuan universe" that enables urban design and creation is a practice of gathering human vision and shaping a better virtual and real life scene for individual and collective. The related integrated technologies and platforms provide the possibility of flexible response, timely prediction and intelligent diagnosis for human personalized dynamic needs [32-33]. In the context of peoples urban design, the universe inspired urban design to build a sustainable and co-created digital open platform, linking individuals with mobile devices, timely obtaining relevant demand information, and design adjustment to make timely feedback to the scene with high sensitivity [341, so as to promote the city to better achieve the goal of people building.

3 "RAR": the method of enabling urban design

In urban design, focusing on the specific methods of urban scene construction, integrating the concept of "meta-universe" and technical realization means, the author summarizes practical experience, and refines the method framework of combining "R" and "AR" —— " RAR (reality augmented reality),

3.1 Connotation of "RAR": virtual and real creation

The definition of the concept of "RAR" revolves around the interpretation of the

connotation of "R" and "AR" and the description of their functional relationship in the context of urban design: "R" is reality (reality), It refers to the real urban scene system that integrates various material and environmental elements and human needs and vision; "AR" is the Gain Reality (augmented reality), Meers under the mesmoic concept, Enabling traditional urban design through technical methods represented by "AR (augmented reality)" technology, Content enhancement of real urban scenes; The "RAR" is the " reality + increase, Refers to, by being represented by the "AR", Including big data, artificial intelligence, blockchain and a series of digital technologies and the reality (reality + auqmented reality) " method, Re-create the real urban scene, With the guidance of "integrating reality and reality" and "promoting reality with virtual", Realize the common vision in the citys market area (Figure 2). The object of "RAR" is urban space, including real space and virtual space; the essence of "RAR" is the creation of virtual space; applying "RAR" method to enable urban design and create future urban form —— "urban universe".

3.2 "RAR" framework: the ten-channel design of the virtual and real space

"RAR" aims at the creation of virtual and real space and develops in the virtual space and real space, which expands the spatial dimension and content level on the basis of traditional urban design. The author summarizes the ten designs of virtual and real space and constructs the framework of "RAR". See Figure 3.

3.2.1 Five-way design of virtual space

(1) Image design

Image design is the creation of urban "image" in the virtual space. This requires designers to visualized the vision in the space on the basis of accurately grasping the vision, which may be an object carrying the cultural identity of the community, a desirable beautiful life scene, or the interpretation of the imagery story. Design will play an important role in it. How to design the space image to better express the yearning, create resonance and convey the value identity is the key to be considered at the beginning of design.

(2) Time design

Time design is to design the movement of "image". The construction of the sense of reality and immersion requires designers to give "virtual life" to the image, that is, introducing the time dimension at the level of three-dimensional static image, design the movement changes according to the image characteristics, and carry out the secondary creation of the space-time trajectory on the image ontology. This requires the design to follow the main proposition of the vision, to create the movement law of the virtual world, and to integrate with the real world, and strengthen the consensus of the collective vision.

(3) Communication and design

Communication design is the interactive design between human and virtual space. To land the dynamic image and the scene, we need to focus on the way to interact with the space object. The foundation of design is based on the perceptual ability of human beings. Designers conduct communication design according to human basic five senses (vision, hearing, smell, taste, touch) and supersensory perception, and design the picture, speech, smell and touch to convey the intention coupled to the vision.

(4) Reaction design

Reaction design is the design of human feedback to the space. After interacting with the object, the object will convey the communication response, which is a bridge to establish the

interaction between virtual and real space and realize the "closed loop". Collect the response of real space through intelligent perception and feedback to the virtual space, and establish a closed loop of "interaction one feedback". Designers need to design the object feedback method, establish the object response mechanism, and effectively convey the information.

Figure 2 Analysis of "RAR"

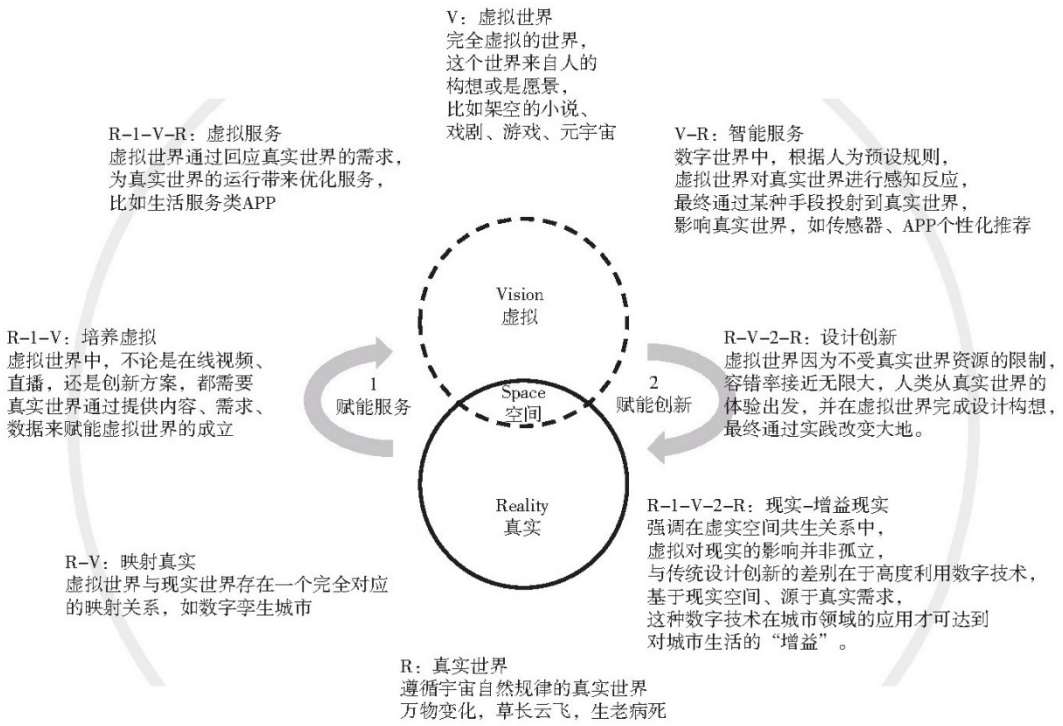
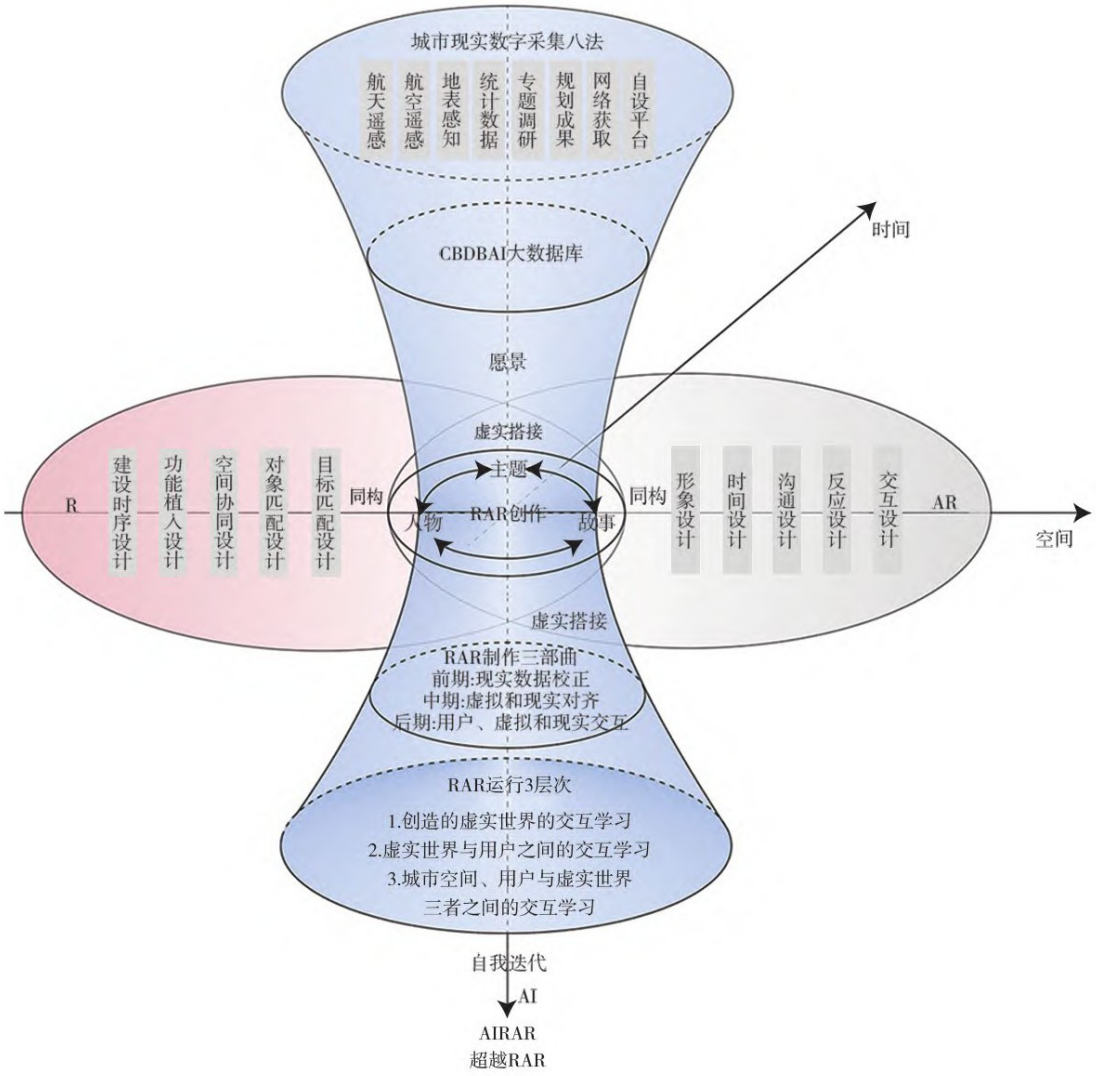


Figure 3. The "RAR" framework



(5) Virtual and real lap connection

Above four design can be in the virtual world relying on digital technology on the computer, turn to the fifth design, need to clarify the possibility of lap between real space and vision, to recognize the real world and the virtual world lack what, through appropriate supplement design, makes the real space "stage" can carry virtual space of "play".

3.2.2 Five-way design of real space

(1) Target matching design

Target matching design is to match the design of virtual space and real space on the basis of traditional urban design target positioning. The landing point of the design is still in solving the pain points and difficult problems, and the design goal should be clear and specific. The virtual world in the vision is different from the real world. On the basis of accurate identification of the vision, it is more necessary to clearly identify the difference between dream and reality, and match the vision of the virtual world with the goal in the real space by intelligent design means.

(2) Object matching design

Object matching design is the design of dynamic demand matching, based on the

demand diagnosis of user objects. In fact, the real owner of the landing space is different from the current vision builders, which requires designers to consider the future users, and transform the vision of the virtual space into a real space scene, so as to match the needs of the object.

(3) Space collaborative design

Spatial collaborative design is the design of how the virtual space is interpreted and coordinated with the real space. From the virtual world to the real world, the shape of the scene must cooperate with the real world, and ground to fall to the real space, first need to consider the real world space scale how to create the virtual world scene together, falling in the real space virtual world scene prototype according to the specific conditions of the real space secondary design, make it match with the real space.

(4) Functional implantation design

Functional implantation design is similar to the functional positioning design in traditional urban design, which involves two dimensions of virtual space and real space. In the real space, "sensible and usable" is the foothold of design and human life. To meet the specific needs of the real world, designers need to implant specific functions into the scene prototype, give the virtual space scene realistic meaning, and provide support for services in all aspects of human production and life.

(5) Construction timing design

The design of the construction time sequence is the implementation-oriented guidance. In terms of the implementation process, we should sort out the specific design goals to be completed in each stage, dismantle the goals, carry out the design and implementation gradually according to the actual situation, conform to the evolution law of human social development, and gradually upgrade and improve the quality from the basic goals. At the same time, the real-time process needs to be forward-looking, consider the changes brought by real world development in advance, and adapt in a dynamic manner.

4 "Urban universe": the practice and technical path of enabling urban design

The author combines the practice of "city yuan universe" on the banks of Minjiang River in Fuzhou and guanhe Street in Taizhou, with details of the technical path for implementation. The design practice of "Fuyuan universe" was launched in the context of the fifth Digital China Summit, To activate the urban waterfront space on both sides of the Minjiang River in Fuzhou, Enabling [35] for the fifth Digital China Summit; The design practice of "Xianyuan universe" focuses on the activation of Guanhe Cultural District in Taizhou city, Comprehensive updates from space experience to business operation, Make it the worlds first [36] to connect the digital economy, Under the methodological framework of the "RAR", The technical path of the project implementation can be summarized into four levels according to the chronological order (Figure 4), namely: (1) to complete the spatial construction through digital acquisition; (2) Two-way design of virtual space and real space, Complete the creation of "RAR"; (3) Develop the AR engine and interactive system to complete the production of "RAR"; (4) Integrated debugging, release and maintenance of hardware and software equipment, Advance the RAR operation.

4.1 Digital acquisition: space construction

The project starts from the construction of spatial data base, which is mainly divided into three steps: (1) preparation before collection; (2) 3 D laser point cloud scanning and spatial

modeling; and (3) data collection of scene content, including problem diagnosis and demand analysis. At the technical level, the three-dimensional point cloud scanning technology of capturing and reconstructing the real environment is mainly used to scan the real scene. At the same time, the accuracy and accuracy are analyzed at the back end of the server, finally modeling the whole picture of the real space of the design object, and the pain points and requirements of the project are defined. In the case of "Fuyuan Universe" project, the team scanned 5659 m in the "Xianyuan Universe" project, the river and view of the street, recorded the formats and operation data, and completed the floor construction from space to content.
4.2 "RAR" creation: the two-way design of the virtual and real space

The design and creation of the "city yuan universe" of enabling urban design is consistent with the traditional urban design. However, the difference is that the design of "city-element universe" involves two dimensions of virtual space and real space, and digital content design is also needed on the basis of traditional space creation (Figure 4). In the project of "Fuyuan Universe", the real scenes on both sides of the Minjiang River are designed as the real floor, the images of goldfish and banyan tree are extracted, and the water is taken as the pulse to give the virtual object movement track and shape the flowing life state. By extracting the key elements of the course of the historical and cultural development of Fuzhou and combining the theme of the Digital China Summit, the story is designed: the first tomb is the millennium crossing, the second tomb is the cross-strait response, and the third tomb is the diversified yu examination (Figure 5). In "Xian yuan word review" day, to actively implement the Zhejiang provincial party committee "makes the excellent traditional culture heritage development of new breakthrough" deployment, "officer river street, fairy yuan universe" in accordance with the "clear water, sheng can swim, street numerous can trade" the overall train of thought, series Dongguan river, south officer river, west officer river, yongning river along the southern song dynasty characteristic cultural resources, through the ancient officer river land channel, in the virtual space in jiangnan landscape, through mobile equipment and real space interaction, trigger experience function, build with text brigade, a brigade, can swim, purchase,A new landmark of "Ten miles of Guan River, a thousand years of Song Yun".see chart

Figure 4 Enable urban design —— The technical path of "urban universe"

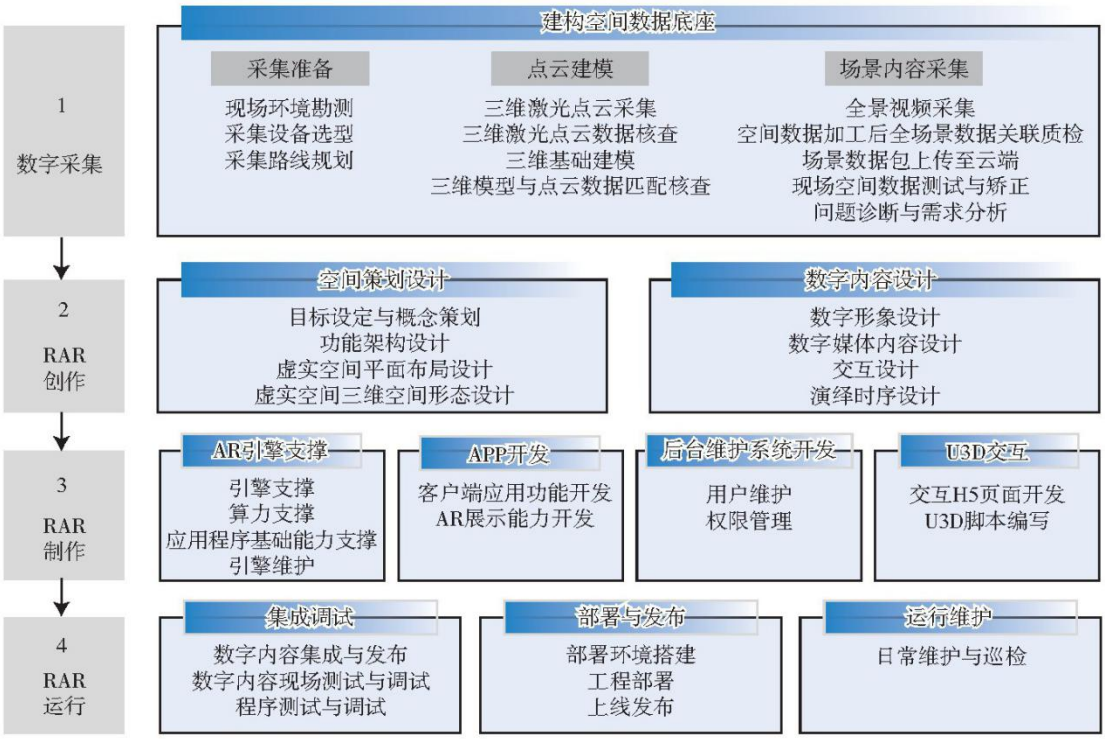


Figure 5 The real scene diagram of the mobile device interactive display of the "Fuyuan Universe" project

Source: Project preparation team of Fuyuan Universe: The Core Section of Fuzhou City, 2022

Figure 6 The real scene diagram of the mobile device interactive display of the "Xianyuan Universe" project

Source: Project preparation team of Guanhe Ancient Road, Xian Yuan Universe, 2022

4.3 "RAR" production: Engine and interactive system development

RAR production can be understood as the implementation of urban design projects. Different from traditional urban design, after the construction of physical space, RAR production is mainly the development of virtual space, specifically: (1) the construction of AR

engine. At the same time, it needs the support of computing power and basic application capabilities. The engine needs to have the centimeter-level 3D high-precision map collection and construction ability of the whole scene, as well as the centimeter-level spatial computing ability, and is able to carry out strong environmental understanding and high realistic rendering.(2) Client development. At present, it is mainly the development of APP, developing related application functions and AR display ability.(3) Background maintenance system development to ensure user maintenance and management of relevant use rights.(4) Development of U3D interaction function, design of interaction pages and scripts. In the Fuyuan universe project, due to the characteristics of the waterfront, the interaction is mainly watching the interpretation of virtual space plays; in the Xianyuan universe project, due to the richness of existing shops and formats, shopping recommendation and consumption interaction are added (Figure 7).

4.4 "RAR" is run:

After the project is completed, integrated commissioning, deployment, release and operation and maintenance should be carried out, which is equivalent to the acceptance of the urban design project. The inspection and maintenance of the presentation effect of the project, which is the key step in integrating creativity and data into the application (Figure 4). After the completion of integrated debugging and the deployment of environment and engineering, the content of virtual space can be launched on the client platform, and the online release marks that the project has entered a new stage. At this time, the application is open to the outside world, and users can start the actual experience. However, routine maintenance and inspection are the key to ensure the long-term and stable operation of the application, including monitoring the application performance, solving emerging problems, and regularly updating the software to meet new requirements or repair known defects.

Figure 7 Real scene diagram of the mobile device interactive display of the "Xianyuan Universe" project (consumption scene)

Photo source: Project preparation team of Guanhe Ancient Road-Xianyuan Universe, 2022

5 Summary and outlook

Starting from the characteristics of the emergence and development of the meta-universe, Explore the commonalities between meta-universe and urban design: from vision, reality based and co-creation, It further proposes three dimensions of urban design: space dimension, time continuity and people co-construction, And define the creation process and result of space-enabled urban design as "space-enabled universe" based on the practical experience of design, The author proposed the method "RAR", The ten-way design architecture of "RAR" is proposed from the perspective of virtual space and real space relationship, Taking the practice of the fuyuan universe and the Xianyuan universe as

examples, The technical path of applying "RAR" method to realize meta-universe enabled urban design is detailed. As a new thinking on the field of urban planning and design brought by the evolution of human technology, the concept of "urban universe" and the method of "RAR" should be constantly enriched with the needs of the development of The Times, and gradually fall into the new scene to solve the real pain points and difficulties of the city. Accordingly, we put forward three points of development thinking.

5.1 Design process

There is no denying the fact that, in addition to the intervention of new technology, yuan universe to the future urban design context combines the traditional urban design and update areas, more fusion of interactive design, digital media design and art design, and many other design areas, the creation process of various design type and digital technology application process, different from traditional urban design field, so its design implementation process similar to the general urban construction update project, and has its uniqueness. In general, the feasibility is stronger, the practice cycle is shorter, and the effect is more significant. From the perspective of implementation and application, the technical path of meta-universe to enable future urban design needs to be more systematic, standardized and standardized.

5.2 Technical standards

The practice of "city universe" is the real urban space, and more clear technical standards need for the design and implementation as the restriction: on the one hand, the application of the new generation of digital technology, such as AR, etc.; on the other hand, the control of urban space changes in the design implementation process, so that the design practice is rational and reliable.

5.3 Future Trends

In September 2023, the Ministry of Culture and Tourism and other five departments jointly issued the "[37] of the Three-Year Action Plan for Innovation and Development of the Space Industry (2023-2025)", which successively launched relevant policies for the application and encouraged the application of the universe to enable the multi-dimensional development of cities. The future urban design is to respond to the specific needs of urban renewal in the stock era, to settle on the urban space, and to effectively put forward solutions to the urban pain points. In the future, yuan universe assigned urban design should be more closely combined with the reality of stock update, more full use of digital technology put forward solutions, "city yuan universe" practice should also be applied to a broader scene, gradually penetrated into the economic, social, cultural and other dimensions, create more dynamic urban life scene, real assigned for urban space.

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