










Innovative Applications of Digital Art and Augmented Reality in the Construction Industry through Building Information Modeling

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Abstract. BIM integrates the information of the whole life cycle of the building and relies on the visual 3D model as the carrier to finally realise the information management and application of the whole life cycle of the construction project. Due to different BIM software adopts different data formats, which leads to the problems of insufficient information sharing and low interaction efficiency in the process of BIM application of construction projects, and cannot realise the information management of the whole life cycle of the building. In this paper, through the BIM mainstream software, the mainstream language C# is used to carry out secondary development of the software, and the detailed model information such as attribute information, material mapping information, geometric entity information, etc. of the building model in Revit is extracted. The extracted information is stored in the common format XML, which realises the complete export of architectural model information of Revit software and provides a strong guarantee for BIM information sharing and collaborative work. Through BIM+AR technology, the building model is built on Unity3D engine, and with AR technology, the model and information are displayed in the mobile terminal without any loss, so that the BIM model and information are seamlessly fused into the real environment to share the information of BIM technology and maximize the value of the application of BIM technology in the construction site.

Keywords : Digital Art; Building Information Modelling ; Augmented Reality; Reality in the Construction Industry

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1 INTRODUCTION

Building Information Modeling (BIM) refers to the process of dynamically creating, collecting, storing, and managing information throughout a building's life cycle. Its data-driven approach to construction and management concepts have been well received by the industry and highly valued by the government, and have been widely promoted and applied. In 2019, China's Development and Reform Commission and the Ministry of Housing and Urban-Rural Development jointly issued a series of guiding opinions on the development of the construction industry, focusing on making full use of the advantages of modern information technology, such as BIM technology, big data, and the Internet of Things, and, in particular, comprehensively advancing the integration and application of BIM technology, and realising the all-around application of BIM technology in the stages of engineering design, construction, and operation and maintenance [3].

However, at present, the application of BIM technology in China's construction industry only stays in the deepening design of three-dimensional modelling and pipeline integration, and the data management and application of BIM in the whole life cycle is relatively shallow. BIM series software contains rich and comprehensive information data, but due to the different data formats of BIM software, resulting in insufficient information sharing among all parties involved in the whole life cycle of the construction project, inefficient communication, and unable to realise the information management of the whole life cycle of the building. And due to the complexity and unpredictability of the construction site environment and engineering construction, the construction programme, although simulated by the BIM, still does not meet the requirements of guiding on-site construction, resulting in the application of BIM technology in the construction site is still limited, and unable to provide targeted guidance. In this context, to promote the integrated application of BIM technology in the construction industry in an all-round way, it is necessary to give full play to the advantages of Internet technology and modern information technology, improve and innovate on the current basis, and solve the current problems of BIM technology in a targeted manner. With the popularity of VR, AR technology and the continuous upgrading of computer hardware and software, mobile devices can be immersed in the project information browsing, three-dimensional model viewing, construction site acceptance and other work, which allows on-site construction personnel to carry out flexible communication and exchanges to enhance the efficiency of the information sharing on the construction site and thus effectively promote the collaborative work of all parties. Therefore, the combination of BIM technology and AR technology can effectively solve the problem of information islands and interaction is not complete, but also enhance the application value of BIM technology, so that "intelligent construction" becomes possible.

BIM model is an integrated platform that integrates a variety of building information, which has great advantages as a source of virtual information for AR application in construction projects, and can realise the sharing and interaction of the whole process of building information. With the rapid development of BIM technology and its popularisation in the field of engineering construction, BIM+AR technology has a good prospect.

In this paper, through an in-depth study of BIM model information extraction methods, BIM + AR technology application methods, in order to solve the problem of incomplete and incomplete information sharing in the application of BIM technology in construction engineering, BIM technology can not be effectively applied in the construction process and other issues. It is of great significance to realise BIM information sharing and promote BIM technology for project full life cycle information management. And through the research of BIM+AR technology can maximise the advantages and value of BIM technology and AR technology, and promote the breadth of BIM technology application development.

2 RELATED WORKS

Regarding the incomplete information sharing, obstacles to the practical application of BIM technology, and the application value of BIM technology that currently exists in BIM technology, foreign scholars have carried out a lot of analyses and researches:

MarjanSadeghi et al.[15] used AutodeskRevit as the main BIM authoring tool and Dynamo as an external programme in order to extend the parametric functionality of Revit, create the appropriate information retrieval documentation and finally generate a maintainable operating system platform in the format required by the user to contribute to BIM information collaboration.Sergio Pinheiro,Reinhard Wimmer et al [14] proposed a standard method for exchanging information between Building Information Modelling (BIM) and BEPS tools using the Information Delivery Manual (IDM) and Model View Definition (MVD) by analysing the problem of data loss during Building Energy Performance Simulation (BEPS) with BIM technology.This method for Building Energy Performance Simulation (BEPS) can effectively reduce data loss and errors.It contributes to the effective transfer of BIM information. ElenaIgnatova et al [7] extracted and processed model data information through Revit software, and classified the extracted information for data transfer in order to analyse various parameters of the building model. The method of implementation of Revit secondary development is also proposed for the research of this paper.

Mehrdad Mirshokraei et al [11] proposed a dedicated web-based system for BIM-AR integration by integrating Building Information Modelling (BIM) and Augmented Reality (AR) technologies, which was effectively applied to building quality management (QM). It reduces the occurrence of omissions and negligence in the construction quality process and effectively improves the management efficiency. Chen Haosen et al [1] proposed an integrated framework based on BIM, IoT, and AR/VR systems, which can be used by fire departments to quickly locate the whereabouts of indoor fires using the data generated by the system, while the VR gamified scenarios can accelerate the development of situational awareness among trainees, providing a huge potential for improving the efficiency of building fire safety and rescue. Garbett James et al [2] labelled construction sites through AR technology and linked the data information to a cloud database. The creation of a BIM-AR system enables construction workers to view 3D models and 2D data through AR functionality, which facilitates the orientation of the construction site. Abhishek RajSingh et al [16] developed an Augmented Reality Supported Build Information Modelling (AR-BIM) framework for Construction Site Layout Planning (SLP), the AR-BIM platform provides augmented three-dimensional (3D) visualisations that can be effective in improving the communication between planners and enable better collaboration among team members. Yeh et al [20] in order to solve the problem of difficult and cumbersome to find information in the construction phase of the project, through the development of AR functional platform, can help the construction site personnel to quickly find and read the required information, which greatly increases the construction efficiency. Meža et al [10], in order to solve the problem of incomplete use of BIM models and information on construction sites, improved the usefulness of BIM models and information on construction sites by designing a BIM-based AR system that takes full advantage of visualisation.

3 METHODOLOGY

3.1 BIM

The U.S. NBIMS standard defines BIM as a digital model with physical and functional characteristics, and BIM embodies the concept of whole-life-cycle management of buildings, encompassing applications in all phases from design, construction to operation and maintenance [19].

BIM is not only a simple 3D building model, it can be applied in the whole life cycle of the building, the data information it contains is the key.BIM through the early project decision-making stage, to the design stage, construction stage, until the late stage of operation and maintenance of the

dynamic data creation and collection, the whole life cycle of the construction project information and data contained therein, all parties can view and analyse the information through their own needs. BIM technology has the following characteristics:

1. Visualization: BIM visual modelling allows the model to be seen and understood at a glance.
2. Coordination: BIM technology shares and collaborates on data based on the same model, so that if one of the parties involved makes changes to the model or data, the rest of the parties can get feedback in a timely manner.
3. Simulation: the simulation of BIM technology can effectively enhance project management in the BIM environment, which is of great significance in promoting the application of BIM and improving the level of project management.
4. Optimisation: BIM technology is combined with VR and AR technology to visualise the BIM model and data information on the mobile.
5. Integration: BIM technology can realise the integrated management of the whole life cycle of engineering construction from design, construction to operation and maintenance.
6. Parametric: Parametric design for BIM is divided into two parts: "Parametric Elements" and "Parametric Modification Engines"; Parametric Elements allow new models to be created by changing parameters in the model; "Parametric Modification Engines" refers to parametric change techniques.
7. Information completeness: BIM technology can complete the description of the whole project information through the information and topological relationships contained in the model objects [6].

3.2 AR Technique

Augmented Reality (AR) can seamlessly connect virtual scenes with real ones and achieve real-time interaction. Unlike VR technology, which is completely fictional and immersive, AR technology integrates interaction, display, and multiple sensing technologies to achieve the fusion of reality and virtual reality, which further improves the user's ability to perceive the real scene, and gives the senses a brand new experience. Comparison of AR and VR features is shown in Table 1.

<i>Category</i>	<i>Virtual Reality (VR)</i>	<i>Augmented Reality (AR)</i>
<i>Features</i>	<i>Immersion</i>	<i>Virtual and Real Integration</i>
	<i>Interactivity</i>	<i>Real-time Interaction</i>
	<i>Conceptualisation</i>	<i>3D Registration</i>
<i>AR Advantage</i>		<i>Higher realism, Lower hardware requirements, Higher registration accuracy</i>

Table 1: AR and VR Feature Comparison Table.

From the table, it can be seen that AR technology has three major features: virtual reality integration, real-time interaction, and 3D registration, among which 3D registration is the most important. Three-dimensional registration technology focuses on solving the correspondence

between computer-generated objects and the real environment, so that the three-dimensional position and size of virtual objects and the real environment are perfectly integrated [22].

The working principle of AR technology is to use computer graphics display technology to generate virtual information that does not exist in the real environment, and then accurately superimpose the virtual information on the real environment to re-endow the user with a new environment that enhances perception (vision, hearing, smell, etc.) The working principle of AR technology is shown in Figure 1.

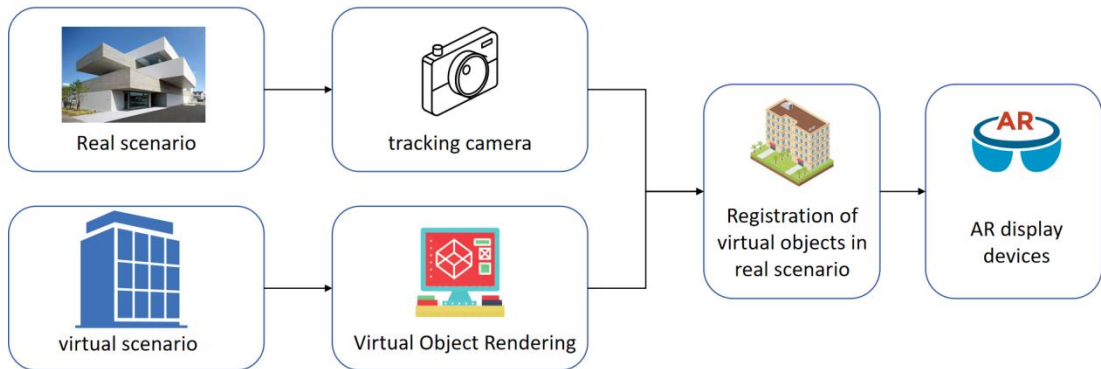


Figure 1: AR Technology Working Principle Diagram.

AR system work generally consists of the following four basic steps, as shown in Table 2.

<i>Augmented Reality (AR) Working Steps</i>	
<i>Step 1</i>	<i>Use mobile device camera to obtain real scene information</i>
<i>Step 2</i>	<i>Track and analyse the target position and camera position information of the real scene.</i>
<i>Step 3</i>	<i>Generate virtual information based on user interaction commands</i>
<i>Step 4</i>	<i>Fusion of real and virtual graphical information and display them together on the screen.</i>

Table 2: Augmented Reality (Ar) Work Steps.

AR technology has the characteristics of real-virtual combination, real-virtual synchronisation, and natural interaction, and is able to support multimedia resources such as text, pictures, video, audio, 3D models, 3D animation, panoramic information, etc., which provides users with a new way of perception.

At present, the application of AR technology has been very mature, and because AR is based on VR technology with the advantages of both virtual and real fusion and real-time interaction, it has a wide range of application prospects in the medical field, the military field, the industrial field, and

the field of ancient architectural relics display. Drawing on the technical advantages of AR technology in other industries, applying it to the construction field has a very great application value in all stages of the whole project life cycle [12],[8],[17].

4 BIM+AR DEVELOPMENT PLATFORM

BIM technology can improve the construction quality of construction projects and reduce the risks of construction building through multi-disciplinary collaborative work, visualisation and dynamic simulation. However, due to the complexity and variability of the construction site environment and the unpredictability of construction projects, safety risks and construction programmes, although simulated by BIM, still fail to meet the requirements of accurately guiding on-site construction. The construction project cycle is generally longer, with more coordinated professions, greater spatial complexity, higher requirements for drawing deepening accuracy, and more stringent requirements for on-site plan positioning and spatial arrangement, which require construction personnel to accurately understand the relevant project status in detail to ensure normal construction. Therefore, the application of BIM technology in the construction site still faces great challenges.

Therefore, it is necessary to display the building model and information in a complete way and integrate it fully with the on-site environment. Combined with BIM and AR technology, project participants can understand the construction parts, construction process, key technologies, construction points and other information more intuitively. Compared with the traditional 3D model, it greatly reduces the workload of professional convergence and the fuzzy space of the programme. The new means of information application management based on BIM and AR can provide a collaborative and efficient information platform for all construction participants, overcome the obstacles of information interaction in time and space, assist on-site managers to make timely and efficient decisions and judgements, and solve the problem of information islands to a certain extent [4],[23],[18].

In this study, Unity3D is used as the development engine for BIM and AR applications based on Unity3D using the Vuforia development platform.

1. The BIM end model is optimised and imported to build the scene, optimising the model material to ensure the authenticity of the model's appearance and colour;

2. Use the C# script control in Unity to parse the XML document containing the model information and add it to the corresponding model components through script compilation to ensure the association and correspondence between the model information and the model;

3. Use Unity3D engine to achieve the development of AR function, download VuforiaSDK in the official website of Vuforia, upload the identification drawings to the official website and download the corresponding Database file, copy the ID identification code, and import it into Unity3D. Create ARcamera and ImagerTarget, place the BIM model and identification drawing under ImagerTarget, and associate the model with the identification drawing. Configure the development environment of Android system and release the Android apk, and install it to the mobile phone mobile terminal.

4.1 Unity3D

Unity3D software is a multi-platform, comprehensive game development tool developed by Unity Technologies. The engine has the significant advantages of higher development efficiency and smooth system, which enables the application of augmented reality technology through the production of 3D videos, 3D games, 3D animations, and so on.

With a high-performance shading system and a well-interacted graphical development environment in Unity3D, it is possible to build AR virtual models.

As a professional rendering engine, Unity3D achieves virtual immersion through a series of scene design. Scene is the spatial scene where all the elements are located. In the scene, the coordinate system conforms to the "left hand rule", i.e. the thumb direction is the positive direction of x-axis, the index finger direction is the positive direction of y-axis, and the middle finger direction is the positive direction of z-axis. When creating a new scene, the MainCamera is created by the Hierarchy option, which displays the game object in the scene, and the attribute information of the object or resource in the scene is displayed in the Inspector toolbar. The operation panel is shown in Figure 2.



Figure 2: Unity3D Engine Operation Panel.

In addition, Unity3D as an extensible all-in-one editor has a strong cross-platform nature to meet developers' needs for secondary development for different platforms. Unity3D editor is compatible with Windows, Mac, iOS, and Android systems, including a variety of immersive experience design and tools to facilitate the application of virtual worlds, in addition to a full range of developer components that enable realistic scene virtualisation. Unity3D enables users to intuitively experience complex virtual scenes realistically by importing a variety of media mediums. In addition to being compatible with a variety of operating systems, Unity3D can run on a variety of terminals such as PC platforms, mobile phones, tablets, etc., and is portable to each other, providing a strong guarantee for AR application development [5],[13],[13].

4.1.1 Environment Configuration and Scenario Building

Before using Unity3D for AR function development, you need to configure the corresponding environment first, the specific process is as follows:

Firstly, you need to download the VuforiaSDK and create the database: download the vuforia-unity.unitypackage function package from the Vuforia official website and create the function database Database, as shown in Figure 3.

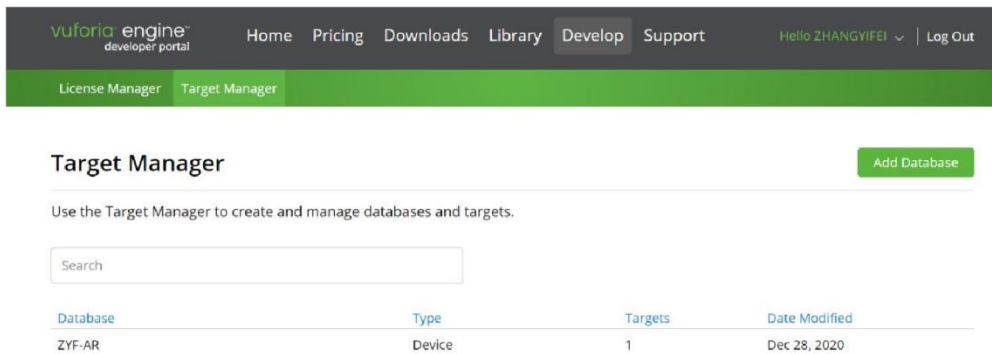


Figure 3: Create AR Function Database.

Once the database has been created, the recognition map needs to be added to correlate the recognition map with the 3D scene, and this correlation can later be achieved by scanning the recognition map with a mobile phone camera. Click Image Recognition Management under the Development tab of <https://developer.vuforia.com/> website and select Add Database to finish adding recognition maps. Upload the downloaded Unity Package file to Unity3D platform to import the project, and then achieve the association between the recognition map and the 3D model. As shown in Figure 4:

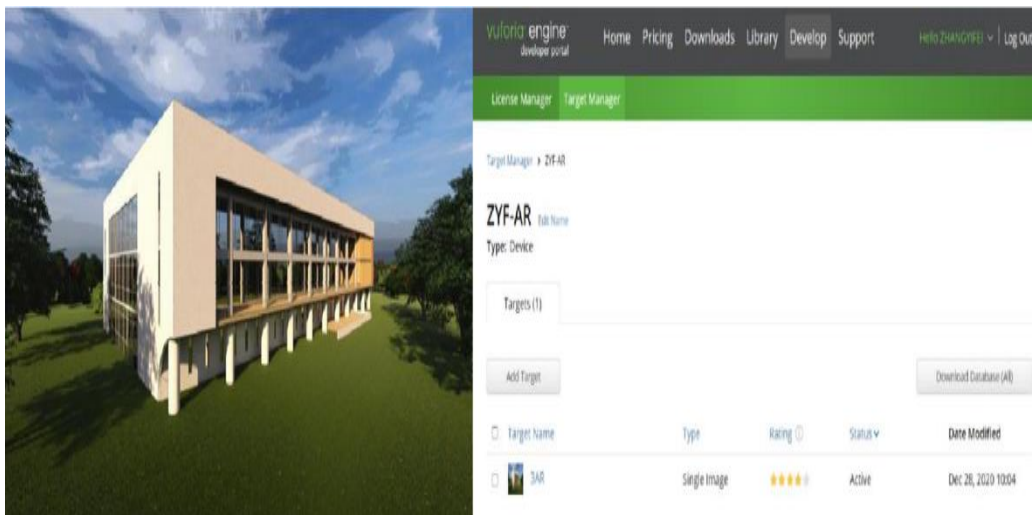


Figure 4: Add AR Function Recognition Map.

Finally, to ensure that the SDK works properly when you create a project in Unity3D, you need to create a License Manage (licence key) for the application in the developer.vuforia website. Copy the License Key in Unity3D, open Unity, click VuforiaConfiguration, paste the key in Inspector, and after that copy the key to add it to Unity3D, as shown in Figure 5.

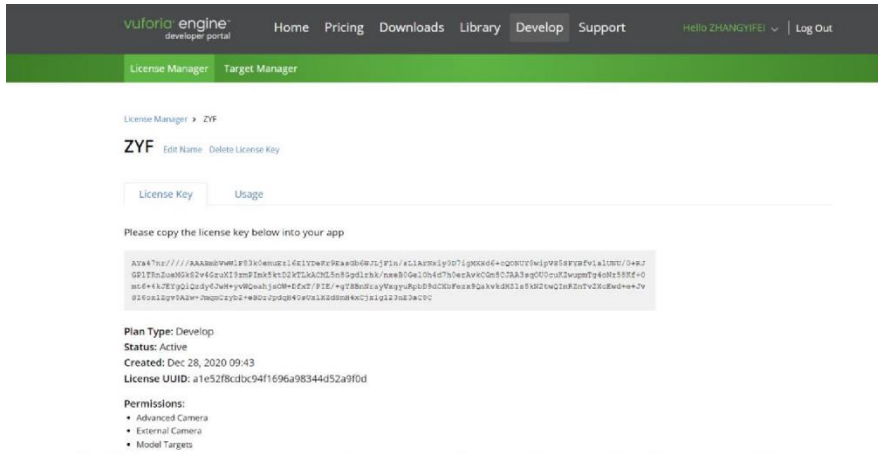


Figure 5: Get the Unity Project License Key.

Through the above steps to complete the system environment of Unity3D, and then you can use VuforiaSDK to build models for AR application development: Drag the Database downloaded from Vuforia platform into Unity, and at the same time, delete the camera in the Unity scene and add AR Camera and ImagerTarget; Put the recognition image into the Assets folder, drag the processed BIM model in .fbx format into the scene, adjust the corresponding material according to the extracted material information, add point light sources, optimise the model to ensure that the model looks clear and consistent with the actual model; Finally, drag the model to the appropriate position above the recognition picture through adjustment to complete the scene creation [21], as shown in Figure 6 and Figure 7.

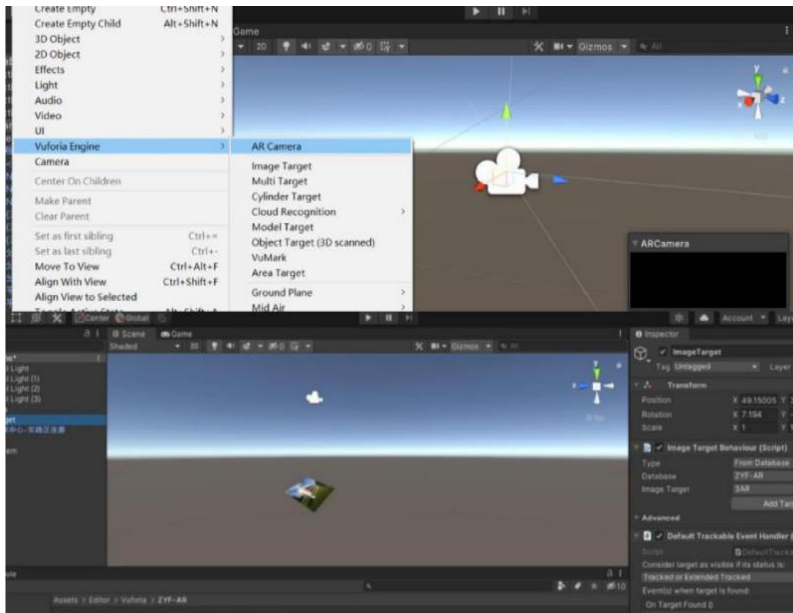


Figure 6: Add ARCamera and Imager Target.

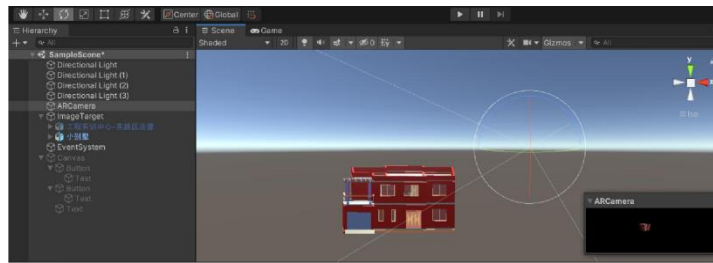


Figure 7: Scene optimization.

4.2 XML-Unity3D Interface Implementation

4.2.1 XML Data Interface Definitions

XML is a tree-structured data storage format, each XML must have a root node. XML extends from the root node to the child nodes at the bottom. In addition to the root node, each node can have multiple child nodes or sibling nodes, and the data attributes between sibling nodes can be borrowed from each other, and the content and attributes of all the elements on my side can be exchanged and used, and its tree structure is shown in Figure 8.

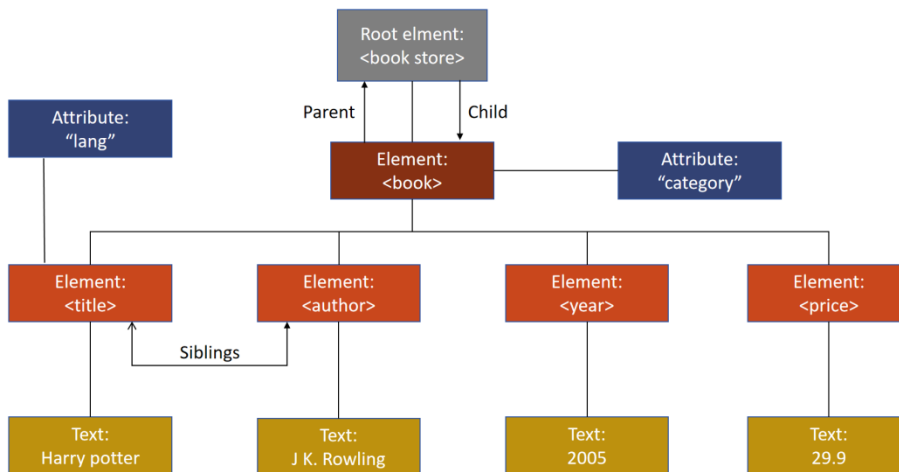


Figure 8: XML Format Tree Structure Diagram.

In this paper, we design the model information extraction method to use XML as an intermediate format for storing building information data, and store the floor information of the 3D model exported by Revit information extraction plug-in in the LayerList tag; The material and appearance mapping information is stored in MaterialList and AppearanceList tags; Geometry information is stored in the ElementList tag of the XML file, and all the above tags are sub-tags of the same level. The ElementList tag stores descriptive information such as component ID and name, and geometric information such as vertices and indexes. The MaterialList tag stores information such as component colour, glossiness, bump, etc. The AppearanceList tag stores information such as component texture, texture, etc. Through the script control in Unity3D, it is one-to-one correspondence with the components to achieve the cross-platform transfer of architectural model information data.

4.2.2 Parsing of XML Files

After the Revit model is built in Unity3D, it needs to read the floor information, coordinate information and index value, material mapping, geometry and other information of the building information model through the script. In XML format, the floor information is stored in the floor node; Material ID, material attributes, RGB values, etc. are stored in the Material node; Appearance ID, appearance attributes, appearance map path values, etc. are stored in the Appearance node; The component Name, ID, and geometric information (points and indexes) are stored in the Element node, and the attribute information is associated by traversing the material ID and appearance ID of the component and performing field matching. As shown in Figure 9:

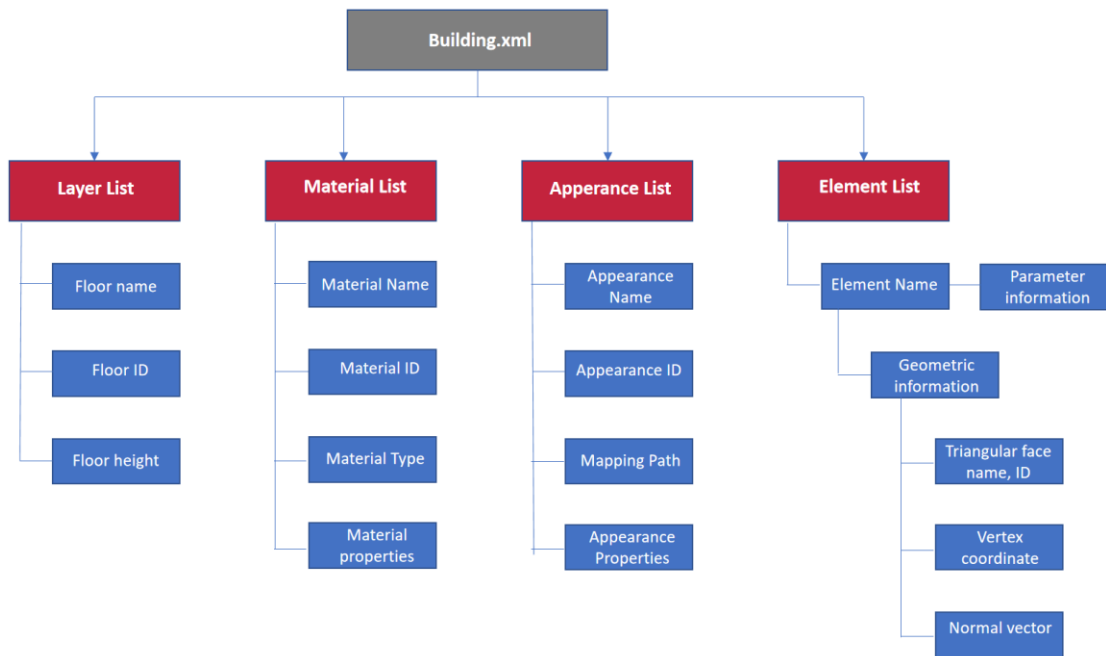


Figure 9: XML Document Data Structure Diagram.

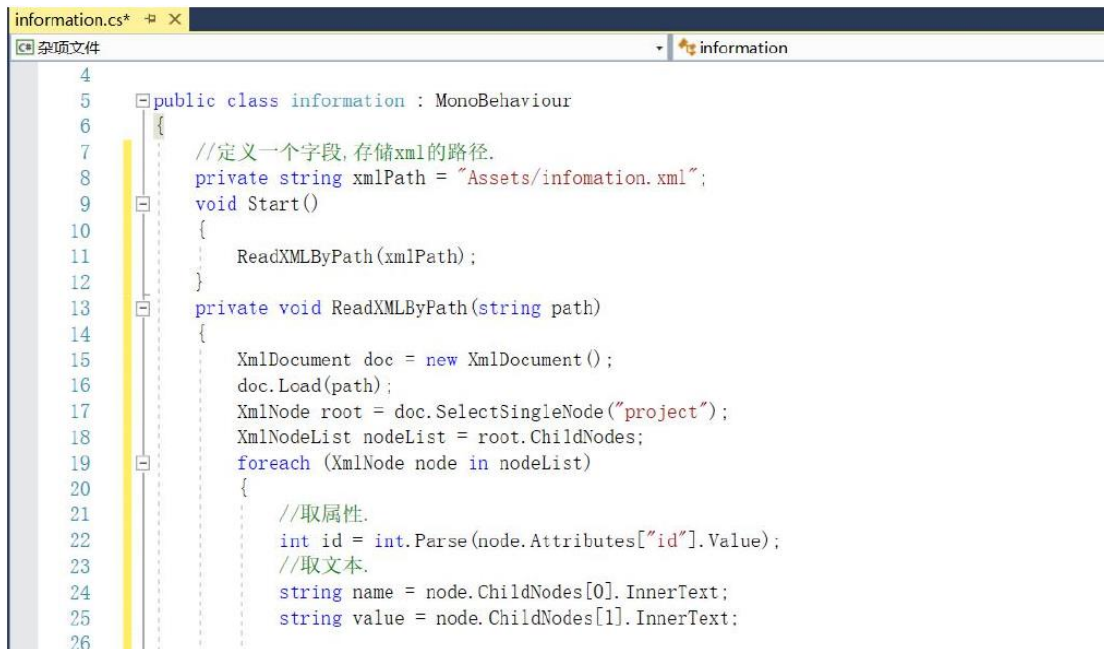
The extracted XML information needs to be read and parsed in order to enable cross-platform transfer and data sharing of model information:

1. Create C#script, edit the script file, use XmlDocument to parse and load the content of the XML document; instantiate the class in the main program and add the corresponding path to load the XML document;
2. Iterate through all the root and child nodes in the loop XML document in order to get the parameter information in all the Element;
3. Construct a structure and declare four structure arrays named Layers, Materials, Appearances and Elements in the main programme, corresponding to the four branch nodes in the XML file, and each array is used to store the data information under the corresponding node. Through the loop traversal of the data under each tag component, and again loop traversal of the node tree under the four branch nodes of all the child nodes, complete access to the model geometry and attribute information, will be obtained to load the information data into the entity Element's structured array, the subsequent work of the required data can be obtained directly through the traversal of the array way.

4. In addition, according to the need to resolve the geometric information to achieve model reconstruction, because the three-dimensional model is essentially presented in the form of triangular mesh (mesh), triangular mesh generation needs to create geometry and define the material.

5. The material information of the component model contains several attributes such as colour, texture and gloss. Traverse the colour object in the Material array to get the RGB value of the model's colour information, and traverse the unifiedbitmap object in the Appearances array to get the texture picture; other attribute information of the model can also be obtained by traversing the query and calling the method, so as to complete the parsing of the material information of the triangular mesh

The XML parsing key code is shown in Figure 10:



```

4
5 public class information : MonoBehaviour
6 {
7     //定义一个字段,存储xml的路径.
8     private string xmlPath = "Assets/infomation.xml";
9     void Start()
10    {
11        ReadXMLByPath(xmlPath);
12    }
13    private void ReadXMLByPath(string path)
14    {
15        XmlDocument doc = new XmlDocument();
16        doc.Load(path);
17        XmlNode root = doc.SelectSingleNode("project");
18        XmlNodeList nodeList = root.ChildNodes;
19        foreach (XmlNode node in nodeList)
20        {
21            //取属性.
22            int id = int.Parse(node.Attributes["id"].Value);
23            //取文本.
24            string name = node.ChildNodes[0].InnerText;
25            string value = node.ChildNodes[1].InnerText;
26

```

Figure 10: XML Parsing Key Code.

4.3 Implementation of Interactive Function Modules

4.3.1 Functional Control Development

The core element of Unity3D creation is to build a scene, which mainly consists of objects, components, presets, and lights. Each component in a model can be considered as a container that incorporates different elements and effects. Such elements and effects incorporated in an object are called components, and different types of components are added when creating different models, and the corresponding functions are accomplished through the components. Components contain references to any other type of component, file, or game object. A model can be configured with many components that exhibit different values or attributes, and different components can run simultaneously without interfering with each other.

In Unity3D, there are many built-in components to achieve the basic functions of each scene. For example, the Camera component is a must for each scene, which generally adopts a perspective camera to image the scene through rendering and output the image of the scene; Box collider component detects the collision effect between objects through the physics engine; Mesh rendering component is used to give material to the object to show the effect of the material. The Transform component represents the spatial position of the objects. The Lighting component determines the colour range and overall tone of the scene. For complex functionality, it is necessary to work with scripting controls. Scripts can appear in the Inspector view in the same way as the built-in components, but they do not usually stand alone and need to be associated with an object in the scene. Custom script components will interact closely with Unity3D. Unity3D specifies that scripts must contain a class that inherits from Unity3D's built-in MonoBehaviour class, and only scripts that meet this specification will be treated as a component. In addition, the script's class name needs to be the same as the filename, or it can't be bound to an object. The execution sequence of the script from start to finish is as follows: Awake is an event function, which means handing over the control of Unity3D to the script temporarily; onEnable calls the script, and onEnable calls the script, which means handing over the control of Unity3D to the script temporarily. onEnable calls the script to perform logic and rendering in sequence. internal Physics Update and Internal animation Update will be called every frame, and the render function will change with the rendering speed. OnDisable is called when a script-bound object is disabled; OnDestroy is enabled when a script-bound object is deleted. The script component life cycle is shown in Figure 11:

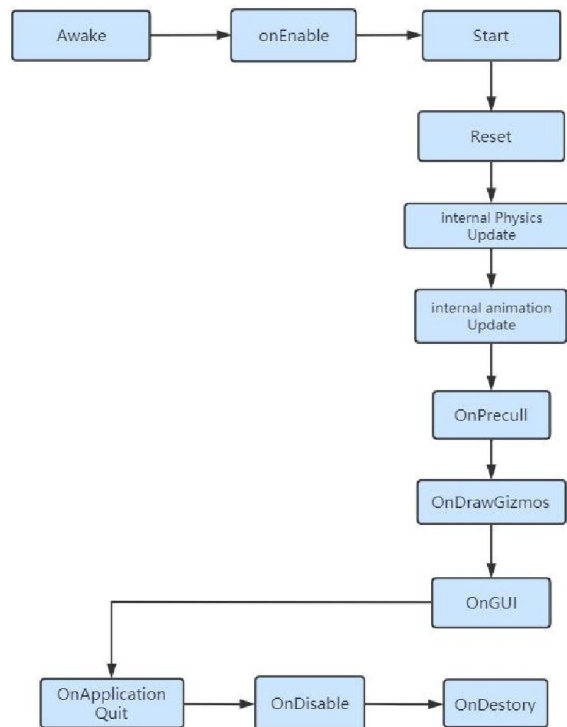


Figure 11: The Life Cycle Of Script Components.

In this paper, the following components are created according to the functional needs: AR camera component is used to implement the AR function, Light component is used to adjust the lighting, and Material component is used to optimise the rendering of the model appearance and material.

For reading and parsing XML document information, script components are used; After the script is compiled, it needs to be bound to the related button components to make the script run normally, and the script and components are bound to each other as shown in Figure 12. In addition, the interface design components will be discussed in the next section.

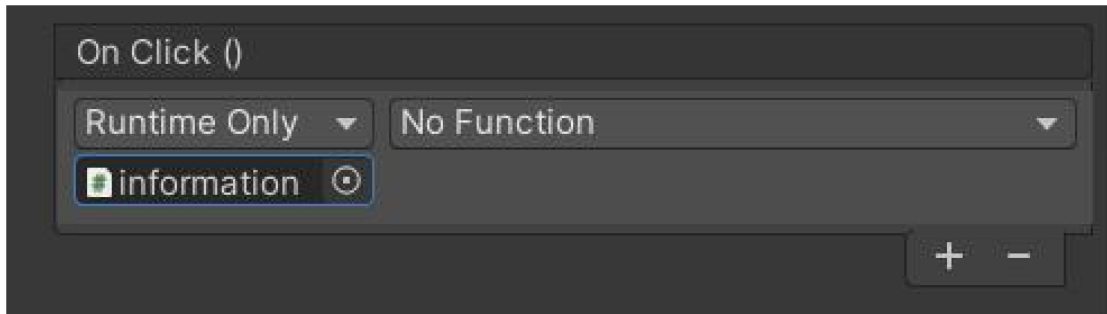


Figure 12: Script and Functional Component Binding.

4.3.2 Interface Design

Unity3D engine comes with a graphical user interface, which provides a visual editor to add simple components such as text, images, buttons, drop-down menus, input boxes, etc. according to the production requirements. In order to seamlessly integrate the BIM information into the construction site and view the information during the construction phase, it is necessary to design the corresponding user GUI, which mainly includes the project introduction menu, the component attribute information query menu, and the core model interface.

When designing the interface, the design of the Canvas component is crucial. The Canvas component is the core of the interface design in Unity3D, and all the UI elements should be drawn on the canvas, which mainly include the following modes: Screen Space-Overlay; Screen Space-Camera; World Space mode (World Space), because the camera in this system is used more frequently, in order to improve the development efficiency, while avoiding unnecessary problems in the setup, this paper selects the first screen space overlay mode.

Unity3D writes event scripts to determine the specific actions to be performed when an event is triggered, for example, clicking a button will trigger the event written in the button. In UI design, functional components are usually added through the GUI classes, and the functions are developed by writing scripts. In order to improve user operability and viewing effect, the UI interface design of this study puts the function menu and operation buttons on the left side of the screen, and the rest of the screen space is used to present the scene content, and the scenes are switched to each other through the design of the menu and development of button functions.

The interface is set up with two buttons, "Project Profile" and "Information Inquiry", clicking on the buttons will display the form and print the relevant information. In this paper, the default window is hidden, and the form and text can be displayed by clicking the button. First of all, through the addition of button components, create a button form to achieve the development of the button function in the scene, and then create a window component script, through the Set Active property to control the visibility of the corresponding scene object, call the On Click function to set the Set Active value, when the click will trigger the button event, to achieve a form to display the other form is closed, to avoid overlapping forms affect the experience! to avoid the overlapping of forms affecting the experience. The overall interface design is shown in Figure 13:



Figure 13: Unity3D Scene Interface Design.

4.4 Demonstration of AR Functionality

Using augmented reality technology, the BIM model can be displayed in miniature on a mobile device to clearly show the structure of the building façade. If necessary, it can be displayed in proportion to the actual size of the building, clearly displaying the spatial information of any part of the building. At the same time, the interactive function enables the viewing of component information and ensures the transmission and sharing of BIM information.

Augmented reality technology is important for communication and guidance during the construction phase. By visually presenting the building model and key information from the model, construction personnel can quickly understand the construction dynamics. Superimposing a 1:1 BIM model in the building construction site environment allows various engineering participants to collaborate on construction and management. At the same time, in the acceptance of the project, the supervisory party can use the 3D model presented by the AR software and the completed nodes to make comparisons, through which quality problems in the construction can be quickly found. The use of BIM plus AR technology will be the past two-dimensional drawings of the technical delivery, directly on the scene for real-time viewing and preview. The combination of AR and BIM itself can provide a good visualisation effect, making the work that used to take a long time to explain to workers much shorter.

Through the AR function display of the villa case, it can clearly and completely display the villa facade structure, and at the same time, through the interactive function, point and select the window components, you can view the basic information of the window components. The effect of the function is shown in Figure 14 and Figure 15.

5 CONCLUSION

This paper is based on BIM and AR-based building model information extraction and three-dimensional display is through the AR technology to continue the design of BIM models in the construction stage of the continuous application, through the establishment of the logical association relationship between the model components and the information, the overall architecture and user interface design, and the AR technology application of the creation of the process and the application of the process of combing and elaboration. Finally, the feasibility and effectiveness of model display

and information interaction on the mobile end are verified through functional tests. The main results of this paper include:



Figure 14: AR Display Of 3d Model Of Small Villa.

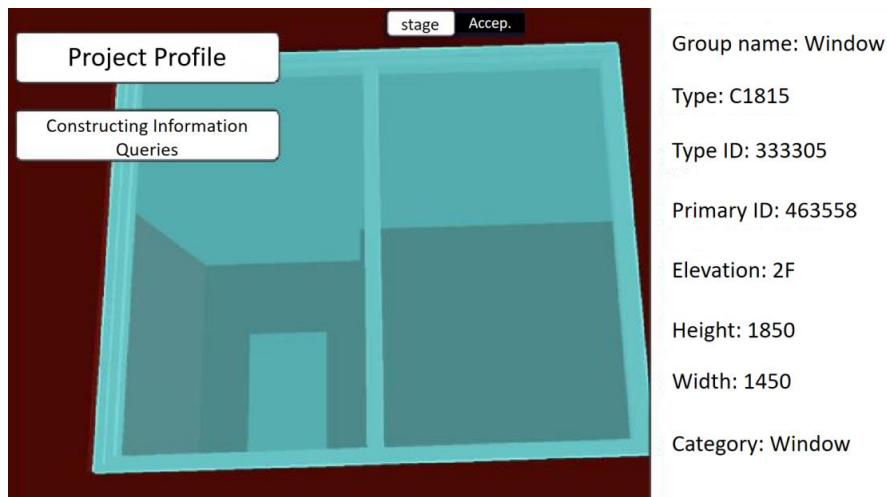


Figure 15: Component attribute information view.

1.The construction method of the model required for the combined application of BIM and AR on the construction site is proposed and studied, the model required for the application is optimised for the scene, and the steps for the establishment of the BIM model and its information to the AR virtual scene model are described. The model information provides information support for the construction site application based on BIM and AR, and provides convenient reference for the construction personnel.

2.The application method based on BIM+AR technology is proposed. Through the study of related technologies and standards, combined with the Unity3D framework, it realises the AR display of the

building model and the query display of engineering information. It provides a reference for realising BIM information sharing and expanding the application of BIM technology in the construction stage.

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