



# Forbidden City

An Immersive Virtual Reality World

Using the **HTC VIVE** to explore the real imperial palace of China

FANG LIU MFA THESIS



# **FORBIDDEN CITY**

THE WORLD'S MOST-VISITED PALACE ATTRACTING  
INTEREST IN CHINESE TRADITIONAL CULTURE



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## An Immersive Virtual Reality World

Using the **HTC VIVE** to explore the real imperial palace of China

Fang Liu

Thesis submitted to the faculty of  
Virginia Polytechnic Institute and State University  
in partial fulfillment of  
the requirements for the degree of

Master of Fine Arts  
in  
Creative Technologies

Thomas J. Tucker, Committee Chair  
Simone W. Paterson  
Dane L. Webster

April 21, 2017  
Blacksburg, VA

Keywords: virtual reality, photogrammetry, immersive environment,  
interaction, three-dimensional, tour guide, educational.

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### ABSTRACT

*Forbidden City* is a 3D virtual tour of an ancient Chinese architectural masterpiece, first of the world's top five palaces -The Imperial Palace in Beijing, China. This travel guide is designed to give you useful information that will greatly enhance your experience, and it will bring you into an immersive virtual world by using the device of the HTC VIVE rather than static texts and images.

This 3D guide integrates cultural and historical information, which is practical and informative. You can get a comprehensive understanding of the palace history, architectural characteristics and Chinese culture through interaction within the immersive experience.

*Forbidden City* travel guide 3D virtual tour provides all the necessary functions and information for planning a visit to the Forbidden City palace in the capital of Beijing, China. With the tour guide character "Doctor Guider" within this experience / game, your tour to this Forbidden City will be purposeful and fun.



# Forbidden City

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### GENERAL AUDIENCE ABSTRACT

Fang Liu

This thesis presents the process of designing an immersive virtual reality of *Forbidden City* using the HTC VIVE. It is a 3-dimensional virtual tour of an ancient Chinese architectural masterpiece, first of the world's top five palaces -The Imperial Palace in Beijing, China.

The history of Forbidden City, the graphic design, 3-dimensional sculptures, 3-dimensional architecture models and HTC integrate system are described in detail. This travel guide aims to greatly enhance your experience. Rather than static texts and images, it will bring you into an immersive virtual world by using the device of the HTC VIVE.

*Forbidden City* travel guide 3D virtual tour provides all the necessary functions and information for planning a visit to the Forbidden City palace in the capital of Beijing, China.

With the tour guide character "Doctor Guider" within this experience / game, your tour to this Forbidden City will be purposeful and fun. You can get a comprehensive understanding of the palace history, architectural characteristics and Chinese culture through interaction within the immersive experience.



# ACKNOWLEDGMENTS

I would like to thank the following people for their significant influence in the *Forbidden City*. This process and project would not have been possible without them.

## **Thomas J Tucker,**

I would first like to express my deepest gratitude to my advisor, my chair committee member Thomas Tucker for the continuous support of my master study and research, for his patience and encouragement, for offering me the summer internship opportunities in group projects and leading me through diverse area of study. I could not have imagined having a better advisor and mentor for my master thesis.

## **Simone W Paterson,**

I would also like to thank my advisor Simone Paterson for providing me with unfailing support and teaching me to build self-confident in my works. She has always steered me in the right direction whenever I ran into a trouble spot or had a question about my research or thesis. I am gratefully indebted to her for her very valuable and useful comments on my thesis project.

## **Dane L Webster,**

I would specially like to express my special appreciation and thanks to my advisor Dane Webster, who has been a tremendous mentor to me. I would like to thank you for your brilliant comments, skills and suggestions to support my works in great ways and to help me get results of better quality. I believe without your consistent and illuminating instruction, this thesis could not have reached its present form.

## **Parents**

No other good words to use today other than thank you, my parents. You have given me the greatest gift of all, education “the best legacy to give a child”. I would not be who I am today without your support. I’m extremely humbled and grateful.

## **Husband**

For your constant encouragement and belief in me. Listening to all my going ons after work and keeping me on my toes on all that I needed to get done. I’m not sure I could have made it this far in life if it wasn’t for your daily encouragement. Thank you!



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# INTRODUCTION

## WHY BUILD THIS VR EXPERIENCE?

There are many reasons that have inspired me to build this VR Experience. Firstly, many people choose China as their tour destination. Especially, the capital of Beijing. According to China Highlights Travel Guide, The Forbidden City is the best-preserved imperial palace in China, the largest ancient palatial structure in the world, and the essence and culmination of traditional Chinese architectural accomplishment. In 1961 the Forbidden City was listed as an important historical monument under Chinese central government special preservation. In 1987, it was nominated as World Cultural Heritage by UNESCO. The Palace Museum is a treasure house of Chinese cultural and historical relics. It is recognized as one of the most important five palaces in the world. Secondly, tourists are not familiar with the history of the Forbidden City, because of the language barriers. There are many online websites only containing texts and images versions. It is difficult to gain a better understanding for foreign tourists.

Therefore, I aim to create an educational VR Experience to promote a better understanding of China and its culture heritage.

## WHAT IS THE VR EXPERIENCE?

I have produced a three dimensional (3D), tourism and educational virtual reality game. It is an 3D interactive playable guide game. It would be very useful and helpful for tourists who are preparing to take a tour in The Forbidden City.

Using the device of the HTC VIVE , the visitor will explore and experience the immersive environment of the forbidden city in 3D virtual world. (See page 08)

## WHAT IS THE PURPOSES OF THE VR EXPERIENCE ?

The Forbidden City is the world's most-visited palace. As a Chinese citizen, I intend this game to attract people's interests in Chinese traditional culture. Players can have a general understanding of the background of the forbidden city throughout this VR experience / game.

Currently, virtual reality tourism in China is not popular. This game is expected to contribute to the growing popularity of 3D visual tourism as well as real world tourism in China.

## WHAT IS THE VR EXPERIENCE USER TARGET?

**Parents and Children. Age 8-12 years.**

This 3D virtual tour is an educational VR experience. This 3D virtual tour will be meaningful and helpful to parents and children alike. When they experience the game as a group it's sure to be fun.





# FORBIDDEN CITY HISTORY

## Game Environment

Forbidden City - Imperial Palace Museum  
It is a symbol in China with the strongest Chinese culture.



Lying at the center of Beijing, the Forbidden City, called GU Gong, in Chinese, was the imperial palace during the Ming and Qing dynasties. Now known as the Palace Museum. In 1987, it was declared a World Cultural Heritage Site by UNESCO.

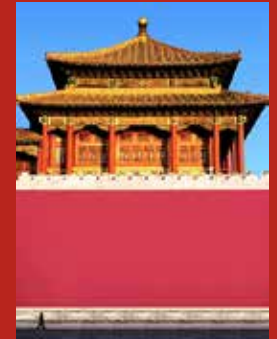


The history of the Forbidden City dates back to 1406 when Emperor Yongle of the Ming Dynasty decided to build an imperial palace in Beijing, modeled after the one in Nanjing. Fourteen years later, the construction of the magnificent palace was finished. It functioned as the political center of China for over 500 years until the Qing Dynasty was overthrown in 1911. Later in 1925, the Forbidden City was transformed into the Palace Museum to display traditional Chinese architecture, rare treasures and curiosities.

Ming Dynasty				Qing Dynasty				Republic of China				People's Republic of China
												
1406-1426	1421	1557 AD	1597 AD	1644	1735 AD	1792 AD	1811	1922	1925 AD	1948	1987	
Planning to move the capital to Beijing, Emperor Yongle ordered the building of a royal palace in Beijing.	The three Jinchou halls in the outer court were burned down in a fire.	A big fire broke down the three main halls in the inner court, the Zhongmu Hall, and many other buildings in the palace.	The three main halls in the outer court and the three main halls in the inner court were burnt down in a big fire.	11 Orders, The Order of a great and glorious anniversary (big fire), Purifying and burning most of the palace's architecture. After rebuilding in the same year, Emperor Muzhuo of the	Emperor Qianlong ordered the Emperor's tomb in Jiaozuo, Henan to be moved to Beijing. The palace was enlarged and reconstructed on a huge scale.	Following was announced by the eighteenth emperor, Yongliang, that a military review in the Forbidden City.	The Qing Emperor's coronation, but did not emperor's coronation, was held at the inner court of the palace.	The Palace of Forbidden Prose (Jingzhi) was destroyed by a fire.	A large number of cultural relics were moved to southern China for better protection during the war.	Some of the cultural relics stored in southern China were transported to Taiwan before the end of the last war.	The Palace Museum was handed to the people after the war.	The Palace Museum was declared a World Cultural Heritage Site in 1987.
1421 AD The construction work of the royal palace was finished.	1442 AD The three main halls in the outer court and the Palace of Heavenly Purity were rebuilt.	1594 AD The palace in the inner court was rebuilt.	1792 AD The reconstruction work was finished.	1735 AD The emperor's tomb was moved.	1813 AD The emperor's coronation ceremony was held in the inner court.	1922 AD The Palace of Forbidden Prose (Jingzhi) was destroyed by a fire.	1925 AD The imperial palace was transformed into the Palace Museum and handed to the Chinese people.	1948 AD The Palace Museum was handed to the people after the war.	1987 AD A large-scale restoration of the museum started. It will last 19 years in 2011.			



The Forbidden City, displays an extraordinarily harmonious balance between buildings and open space within a more or less symmetrical layout. Rectangular in shape, it is the world's largest palace complex and covers 74 hectares. Surrounded by a six-meter-deep moat and a ten-meter-high wall are 9,999 buildings. The Forbidden City is divided into two parts. The southern section, or the Outer Court was where the emperor exercised his supreme power over the nation. The northern section, or the Inner Court was where he lived with his royal family.



It was said that a million workers including one hundred thousand artisans were driven into the long-term hard labor to complete the city. The bricks were made from white lime and glutinous rice while the cement is made from glutinous rice and egg whites. These incredible materials make the wall extraordinarily strong. Since yellow is the symbol of the royal family, it is the dominant color in the Forbidden City. Roofs are built with yellow glazed tiles; decorations in the palace are painted yellow; even the bricks on the ground are made yellow by a special process.



<http://www.topchinatravel.com/china-attractions/forbidden-city.htm>

Nowadays, the Forbidden City, or the Palace Museum is open to tourists from home and abroad. Splendid painted decoration on these royal architectural wonders, the grand and deluxe halls, with their surprisingly magnificent treasures will certainly satisfy "modern civilians".



# 2D GRAPHICS DESIGN

## MAIN CHARACTER DESIGN CONCEPTS

Chinese art is swarming with bats. They fly in formation around vases, and follow each other across the finest fabrics. The Chinese symbols, or characters, for “bat” (蝠 fú) are the homonyms of “fortune” (福 fú) or “blessings.”

People tended to paint five bats in paintings to symbolize the “Five Blessings,” health, long life, prosperity, love of virtue, and a tranquil, natural death. Often depicted in red, a color of joy, bats represent “good fortune” in traditional Chinese culture.

In antiquity, silk fabrics and brocades were often woven with bat shapes. In fact, there were also bat shapes in the fabric flowers on women’s heads, costumes, and utensils used in weddings, birthday parties, and other occasions.



<https://www.youtube.com/watch?v=CKCxRV5mdOs&t=2s>

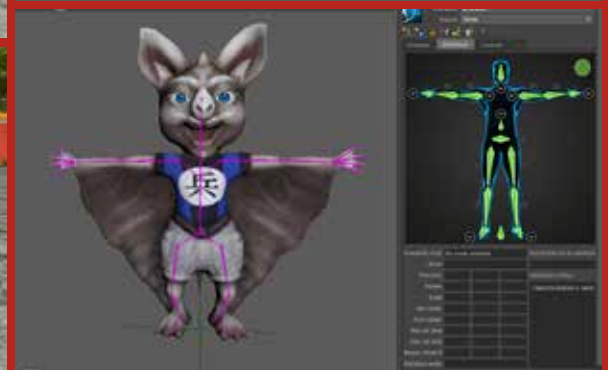
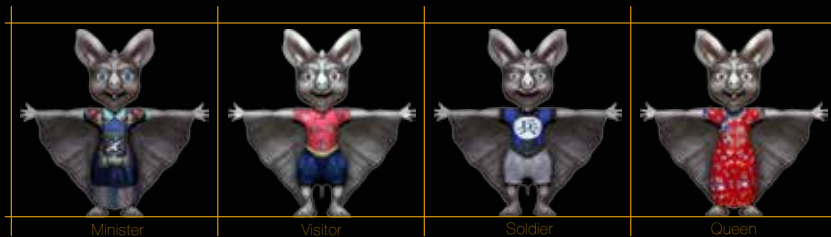


# 3D CHARACTER SCULPTURE & APPLICATION

## BATS 3D CHARACTER SCULPTURE PIPELINE

<https://www.youtube.com/watch?v=3g7gCO1Xks&t=2s>

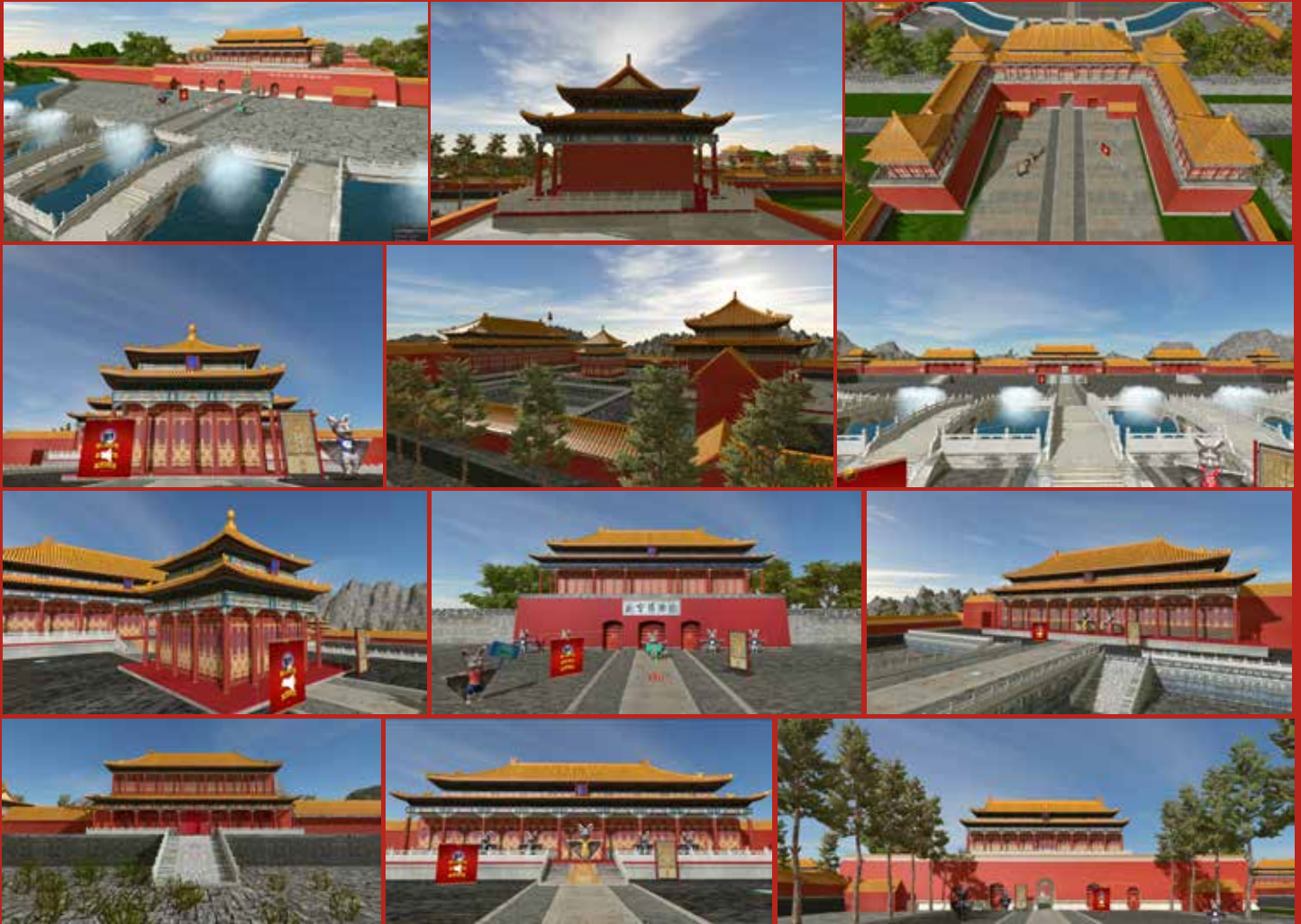
DIFFERENTS BATS PLAY DIFFERENT ROLES IN THE FORBIDDEN CITY





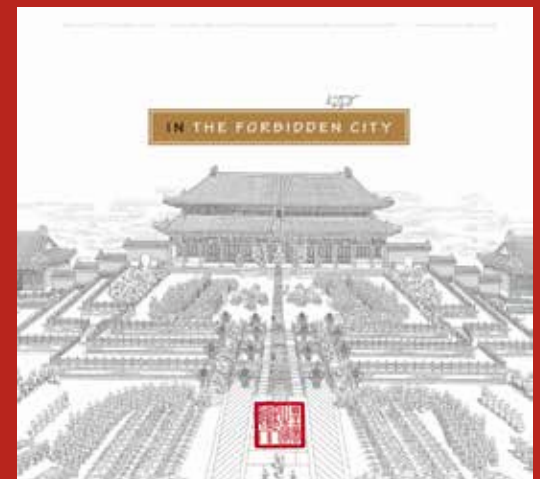
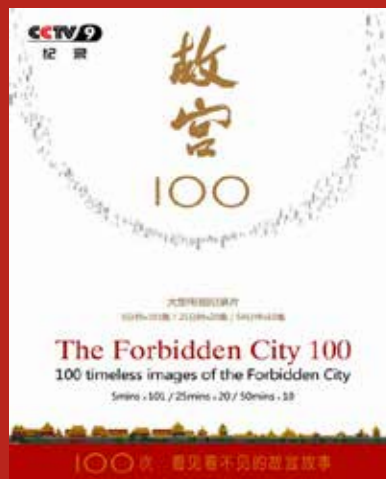
# 3D ARCHITECTURE MODELINGS

<https://www.youtube.com/watch?v=Tb7hnWlbrcc&t=3s>



## RESOURCE MATERIALS

The background information of Forbidden City is referenced from the following three books, which are significantly helpful and informative.





# FORBIDDEN CITY HISTORY COLLECTION

The following signs can be read on the game.



## Gate Of Heavenly Purity

The Gate Of Heavenly Purity marks the border between the Outer and Inner Courts.

There is a marked difference between the air of regal authority of the Outer Court and the more domestic concerns of the Inner Court. The designs of both courts are meant to mirror each other; the three main palaces of the Inner Court mirror the three main palaces of the Outer Court on a smaller scale. While the Inner Court was meant to be the residence of the emperor, it gradually took on more official functions, as emperors got tired of and retreated from the ceremony of the Outer Court.



## Gate Of Heavenly Peace

Tiananmen Gate, also called "Gate Of Heavenly Peace" is the southern entrance to the Forbidden City (Imperial Palace). The gate has five rounded arch doorways, and seven Golden Water Bridges—the central bridge was used by the Ming and Qing emperors only, the other bridges were for royalty and court officials. From the wide tower, emperors read out proclamations, and this is spot where Mao stood in 1949 and declared a new China. Step through the Tiananmen Gate, and you'll enter the Forbidden City.



## Hall Of Preserving Harmony

The function of the Hall of Preserving Harmony changed over the centuries. During the Ming, it was used for ceremonial purpose related to the imperial family; while during the Qing, it was used as both a banquet hall as well as the examination for the top candidates in the all-important Imperial Examination—presided over by none other than the Emperor himself.



## Hall Of Central Harmony

The emperor would rest in the Hall Of Central Harmony before he attended grand ceremonies.



## Hall Of Supreme Harmony

The Hall Of Supreme Harmony is the largest hall in the Forbidden city. From here the most important events in the empire were marked: the coronation of the emperor, the marriage to the empress, imperial birthday celebrations, lunar year ceremonies and the most important imperial proclamations. The emperor was considered the "Son of Heaven" and it was here that "heaven and earth" were thought to meet. During these ceremonies civil and military officials would line up in the courtyard according to their duty and rank, with 72 raised bronze markers placed on the ground to indicate where each ranking should stand or kneel.



## Gate Of Supreme Harmony

The 10,000 square meter courtyard in front of the Gate of Supreme Harmony is made entirely of paved brick—no trees or vegetation was permitted to grow here since the Emperor was considered the ruler of earth, no wood elements could trump his lofty position.

The bikes were specially made to create a pleasing sound when walked upon. It was here during the Ming Dynasty, that emperor held morning court and imperial edicts were issued.



## River Of Golden Water

The River of Golden Water is located in the first courtyard of The Forbidden City. The water for the river flows from the west, the direction associated with gold. From overhead it looks like a bow, or a jade belt.

There are five stone and marble bridge over the river. The middle family used the two flanking bridges, and the outer two bridges were for court officials. Having a man-made river inside the palace was also useful for fighting fires.



## Meridian Gate

The Meridian Gate, located at the front of the forbidden city, would open only for events related to national affairs.

Normally, the emperor and the resident of the Inner Court would enter and exit the Forbidden City through the Gate of Divine Prowess at the back. When reporting to court, the ministers would most often enter the palace through the East and West Prosperity Gates, whereas imperial relatives entered the place mostly through the West Prosperity Gate or the Gate of Divine Prowess.



## Gate Of Correct Department

It is almost identical to Tiananmen, Gate Of Heavenly peace. Gate Of Correct Department was used to store ceremonial dress for many of the attendants, ministers, and soldiers who would join in processions when the emperor would either host a celebration within the palace or would venture out into the city to perform rites at one of the temples.



# HTC VIVE INTERACTIVE SYSTEM

The *Forbidden City* game / experience main menu system.



The *Forbidden City* game / experience interactive / simulation





# FORBIDDEN CITY VR FEEDBACK

David Hicks- School of Education

The environment you have created is tremendous. Clearly a great deal of time, knowledge, skill, and effort has gone into you building this environment. I think a user would truly begin to understand the scale of the Forbidden City as they transport themselves around. I really like the detail, contents and teleportation features.

- Create an **orientation section** to the game that gives users the mission/mystery and the questions and materials they will need to find to solve/complete the mystery.

- Think of developing a **reward system** to help users remain motivated as they look for information/clues to meet your learning goals.

- Consider developing a **user guide** for teacher and students that can be downloaded to introduce the game and provide them with key learning outcomes etc.

# FORBIDDEN CITY VR EVALUATION SURVEY

TS: VIDEO GAME DESIGN STUDENTS

## POSITIVE FEEDBACKS

- Strong color and textures, looked very good quality overall the bat characters added a very playful element that I enjoyed the water, sky and tree animation made it even more immersive very well done.
- The simulation is fantastic to absorb the info. It is easier to learn from tour then from the textbook
- Jumping around the place to exploring the buildings was my favorite.
- The panels are very informative and I am learning a lot from the model and the culture as well.
- The simulation creates a really cool visual for the lesson.

## NEGATIVE FEEDBACKS

- This was the first time I ever used this technology and it was confusing.
- The headset did not stay on my head very well but holding it up was okay.
- It is a bit strange to use the controller. It is not intuitive.
- Not 100% comfortable with the navigation, but this is not the VR experience fault. It works perfectly for what it is.
- You will get stick in buildings sometimes.
- A few of the panels were hard to read in VR





## FORBIDDEN CITY FINAL GOALS

The following two goals will be pursued over the coming weeks.



UPLOAD THE FORBIDDEN CITY VR EXPERIENCE FOR FREE DOWNLOAD. USERS CAN TEST IT GIVE FEEDBACK AND RATE.

APPLY FUNDINGS FROM THE FORBIDDEN CITY PALACE MUSEUM, GOOGLE AND SAMSUNG COMPANIES TO IMPROVE AND COMPLETE THIS RESEARCH



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