

# REVIVING OF HISTORIC MONUMENTS BY VIRTUAL REALITY TECHNOLOGY

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## ABSTRACT

*Virtual reality has gained large effects in preserving and recreating the historical monuments in many Asian countries such as Japan and Thailand. However, it is a new technology in Vietnam. The aim is to bring virtual reality into social life, creating helpful products based on 3D graphical application programming.*

*In this paper, we present a technique to restore historical monuments that can create impression about going back in time by 3D images and sounds, to make the scenes more realistic. We believe that our work would be a meaningful contribution to the upcoming event of Thang Long – Ha Noi 1000<sup>th</sup> anniversary.*

**Keywords:** *virtual reality, simulation, computer graphics, Thang Long – Ha Noi 1000<sup>th</sup> anniversary, computational geometry.*

## 1. INTRODUCTION

Hanoi was built since 1010, at first it bore the name of Thanglong in the reign of King Ly Cong Uan. The hallmark has not faded according to the bygone years and the most noticeable thing is that the Imperial Citadel, with palaces of the monarchs; the historical city gates used to safeguard the former fortifications and the Old Quarter with 36 streets formed during the 15<sup>th</sup> century, still remain there. Each inch of ground, each space still feature some vague atmosphere of history, is imbued with the sacred soul of river and mountain. Therefore, a good many ideas, quite a few solutions in order to preserve, recreate, embellish, and develop the capital city are capturing the attention of many people and circles inside and outside the country.

Being aware of the importance in terms of sustainable cultural values in many respects of the Old Quarter and other relics, in numerous articles about research on Hanoi, experts have presented not only dry substantiations but also analyses, suggestions on a scientific,

reasonable, soulful basic so as to build the Capital on a par with the magnitude of this city, and restore the graded historical works that are gradually degrading.

Statistic data of Urban and Rural Planning Institute (Ministry of Construction) have shown that there in Hanoi at present exist 169 ancient houses (dating back to the 15<sup>th</sup>-17<sup>th</sup> centuries), 211 houses built during modern time (late 19<sup>th</sup> and early 20<sup>th</sup> centuries), and 25 temples, pagodas, shrines, communal houses, churches, etc. These are extremely valuable historical, architectural, cultural relics that our ancestors have handed down for today and generations to come.

First, with regard to the **Old Quarter**, this is the place to preserve numerous tangible and intangible cultural heritages of the whole country in general and of Hanoi in particular. The term “36 streets” originate from the organization of the 36 basic and typical administrative units in the feudal time of the Le Dynasty (divided in the form of guilds with different trades). On the grounds of the 36 old streets, such ones as Hang Bac, Hang Chieu, Hang Ngang, Hang Dao, Hang Quat, etc. which occupy an area of 450 hectares and are possessed of over 80 historical works including pagodas, temples, and shrines. Ancient trades, new workers, and here and there lyrics of new song can be heard. “Hanoi in autumn...the old houses with dark brown tile roofs”... Each street was called after the name of a trade, and associated with a feat-of-arms during the historic 12 days and nights battle. The Old Quarter with 36 streets lying in the east of the former Imperial Citadel was the busy fresh pots and hubs of commerce which added charm and richness to the urban city; it was an integral part of the ancient urban structure of Vietnam in general and of Hanoi in particular; its existence up to now, though not completely intact, still is characterized by an ancient urban city that only Hanoi possesses. It is believed by researchers that this is one of the cradles that gave birth and fostered of legends, popular songs, traditional tales and festivals...

The Old Quarter is a unique overall architecture complex; the streets are straight, short, with some curves, breaks into some sections, heaving tile roofs covered with green moss.

The traditional architecture of communal houses, pagodas, temples, etc. with highly skilled sculpture on good kinds of wood to create artistic figures on the trusses, rafters structures, doors, altars, and such other furniture as beds, wardrobe, cabinets, chairs, shelves, etc. are the architectural products typical for different period of the country’s development, and part of the spiritual life and the soul of the capital’s inhabitants.

Along with the Old Quarter, other relics are characterized by their sense of community, which is connected much with spirit, with tradition of building and safeguarding the country, for example, the Imperial Citadel which was excavated in 2004, is an event of great importance, a precious national object needs that the State, functional sectors and the entire people should take a loving care of, respect, take pains, intelligence, money and property so as to restore and preserve.

To say about Hanoi with the 36 old streets, nevertheless, one cannot go without mentioning Hoan Kiem Lake – an important constituent of the old land area that made up the former Thanglong Capital. The existence and development of Hoan Kiem Lake is not only connected with the legend about the marvelous sword of King Le Loi but also embeds in the memory of each Vietnamese the image of the glistening Tortoise Tower, of the The Huc Bridge silhouetted against the emerald water and the age-old Ngoc Son Temple. Hoan Kiem Lake – that is the point where admirations of visitors from every corner of the country converge whenever they arrive at the capital city.

Hoan Kiem lake and its vicinity are a model of the space structuring art. Here, there is an open space system; squares, parks, lake in an uninterrupted relation with the space circulation system have significance in creating urban aesthetic landscape. This is a modest style of architecture suitable for the tropical climate conditions and for the people to live harmoniously within.

For the present time, however, the Old Quarter of Hanoi is confronting major challenges. Over many consecutive years, the loose management, arbitrary issuance of permissions, law observation, poor conscientiousness of part of the population... have degraded and caused the loss of hundreds of ancient cultural architectural works. Delay in planning, and settlement cases in a passive manner, etc. have impeded the works of improving, restoring, expanding, maintaining relics, including the Old Quarter.

Just like a sleeping beauty in a place, Hanoi has awoken; Hanoi is being taken care by experts, architects, planners, policy-makers, and information technology workers, particularly those who work in the area of virtual reality technology, and the entire people in order to restore, recreate, and build an ancient, chivalrous, sacred Hanoi to be the confidence in the heart of each citizen.

## **2. SOLUTIONS**

Virtual reality technology is enjoying a boom in the world. For the time being in Vietnam, virtual reality technology is gradually being paid attention to on account of its advantages. As a digitalized image technology that simulates in a dynamic way, virtual reality technology is being applied by Center for Information Technology and Digitalized Solutions in recreating the images of those historical relics that are gradually degrading and wearing away. The system is intended to simulate the effects and observation upon inspection over a certain area. This system is the combination of simulation techniques using 3-D graphic images with specific hardware equipments.

### **2.1 Composition of a virtual reality system**

A virtual reality system is made up by the four following constituents: *effector*, *reality simulator*, *application*, and *geometry*.

*Effector* is any interactive type of equipment that permits access to a virtual reality. These include output equipment capable of exciting the senses to create a sensation of being existing in a virtual reality. For example, the overhead screen HMD, mouse, stereo headphones, and input equipment capable of recording the place the user is looking into or the direction that is being headed, *head-trackers*, *wire-gloves*, for instance.

*Simulator* is the heart of a virtual reality, which includes a computer system and peripheral hardware, graphic equipment and multimedia, providing the effector with necessary information on the senses. For the driving cabin simulation system, the cabin model is the very this constituent.

*Application* is the software that simulates the contexts of assumption, dynamics, its structure, and principles of interaction between objects and the user. Application creates the world of virtual reality and concrete simulation requirements. Applications abound in forms, and depends on platform (Intel, Sun, SGI, etc.)

*Geometry.* This constituent comprises simulation information on physical properties (form, colour, location, etc.) of objects in a virtual reality. Normally, such objects are created by software, for instance, CAD, and then data can be transmitted to one of other file format conformable to the presentation in the application.

## **2.2 Requirements for a virtual reality**

For this system, there are the two most important that need to be met as follows:

- First, to make up the 3-D model of the total area that needs be preserved, with the best graphic display quality possible. The 3-D measurements mentioned in the previous paragraph will help us recreate the relics, reproductions, houses and other 3-D objects on the computer. At present, we have carried out the formation of a 3-D model of Ngoc Son Temple in detail. This model was formed by soaking and covering the surface architectural structures by simulation technology thus, the geometric frame was created by the software Multigen Creator and then converted into specific data of the display mode, which would enable the user to inspect from different angles. When the recreation of ancient cultural heritage is under way, a system of samples will be created basing on the date taken directly on the relics to form the model on the computer. Through this, a museum of historical data would be established. The success of this project requires that historical researchers should work seriously in close association with virtual reality.
- Second, to formulate a simulation program in terms of effect images when the area is investigated by the user. Since the graphic display quality serves as the foundation for any virtual reality system, though visual images, scenery, the user can perceive the fidelity of the simulation system. With today's graphic techniques, it is possible to simulate almost all graphic effects with premium quality so as to help create simulation and virtual reality products.

For the time display system, the best condition for image frames to be displayed on the screen is between 60 and 85 frames/second. To understand further, let us have a look at the difference between virtual reality 3-D and 3-D tableau.

Tableau is used in Multimedia products, particularly in creating film, or graphic products catering for printing work. Meanwhile, real time graphic software is applied in simulation applications, for example, flight training, driving training, games that have interactive capability. Both these kinds of product use highly detailed real model images together with algorithms so as to smooth the changing moods of graphic scenery, through algorithms to shine the number of context frames within a time unit, yet there remain some differences as follows:

- Simulation software entails the number of frames in real time, that means the frames must be continuous while data is updated (including location and observation direction). Meanwhile for tableau, the number of frames must be preset, and it takes hours to create scenery.
- Simulation software entails a high level of interaction so as to control the movement of objects in the scenery. Tableau does not allow interaction, the user perceive the scenery in a passive way.

- Another important difference is that interaction in simulation is on purpose. In addition, a model in simulation is somewhat less detailed compared with tableau for the purpose of increasing the number of frames.
- Simulation software entails that the number of frames must reach 15-60 fps, depending on the level of complexity and scenery details. Meanwhile, film always entails that the number of frames must be 24 or other, as per requirements and standard for it, yet the number of frames is invariably fixed according to time.

### **2.3 Geometric data**

The much-preferred data standard OpenFlight depicting data 3-D comprises full 3-D algorithms and digitalized topography in order to build up software products to simulate real time interaction. More than other basic chemical simulating tools, Creator is designed to create a model with the least number of faces so as to reduce configuration requirements for computers running in real time. In addition, it also provides 3-D model interface in the form of family tree as per OpenFlight (.flt) standard. This standard will become data for some products developed on the VEGA library background or OpenGL-based libraries.

To date, the members of the group have developed the virtual reality models of Ngoc Son Temple, which allow viewers to visit the temple in real time. We used the architectural sketches, together with high-resolution photographs and videos to create the virtual models of the temple's precinct. The viewer may use a mouse to explore these models in real time; zoom in to study paintings engraved on the walls in detail, or zoom out to have the overall view of the temple's interior decoration. Every tiny detail such as furniture, colour, and structure of the works has been portrayed in a way authentic to history. Furthermore, the setting, light, and sound also change according to observation positions. The project is aimed at providing a new choice in place of photographs or diagrams of artifacts, and at the same time, helping those who wish to learn about history be able to wallow in the atmosphere of the past. This technology permits the restoration of those heritages that are at stake, with the air and context of the buildings at different times in history. The virtual reality technology will give the viewer the impression that he or she is going back in time, with images presented in three dimensions and stereo sound on a wide screen, and that he or she is living a real life in a virtual space.

## **3. RECREATE THANGLONG-HANOI CITADEL**

### **3.1 Interview**

The previous introduction let us see an actual state of ancient citadel is being downgraded very quickly and more and more buried in oblivion.

Meanwhile, people in Hanoi in general and Viet Nam in particular very desire to visit, contemplate beauty as well as culture value, history of Ha Noi Ancient Citadel.

We could take some questions:

- Nowadays, people could see how many percent original Ha Noi Ancient Citadel monuments is?

– When is Thang Long Imperial Citadel restored its stature according to valuable and rare culture monument?

– Can we enough expenditure, time, as well as other different condition to able to restore, regenerate Ha Noi Ancial Citadel?

The question is still remain, meanwhile historians, artists,... are being absorbed in research, reappear images of Ha Noi Ancial Citadel. But they aren't enough for people have total seeing about Ancial citadel...

And reality isn't desire still existing:

– Ha Noi about 120 ago is very oddly in people's eyes today.

– The ancients aren't over, many scene also disappear. It only remain relic ratify archeology.

– It only remain some pictures to bring about unexpected and touched...

### **Content of work**

– Building perspective and inside citadel: The citadel is square, each dimension about 1 km, perimeter about larger than 1km<sup>2</sup>. Walls of Citadel were built up box brick, foundation of citadel was built up green brick, wall about, opened up 5 gate: East-West-North-South East and West South Gate, outside each gate has piece of Citadel was called Duong Ma Citadel to safeguard that gate.

– Building architecture perspective inside Citadel: There are Kinh Thien Palace, Flagstaff, Hau Lau Palace,... In front of Flagstaff, there is Voi lake where place governor's office and government official as Ministry representative. There are storehouses, school of martial art, heaven and earth sacrifices place, penitentiary, execution grounds called Place punishment, Dinh Ngang Cam Chi outside South Gate. There are sentinels for each gate.

– **OutSide citadel:** There are barracks, streets and districts later (they are both belong to HOAN KIEM district and were called old streets).

This project is great significant scientific, culture, society and history, since then assert technology and technique .

People can conpemplate, seeing Ha Noi ancial citadel - a great cultural heritage, at the same time it help culture research, archaeological, history ... Easy for looking up, finding information about Ancial Citadel

### 3.2 Hardware connection

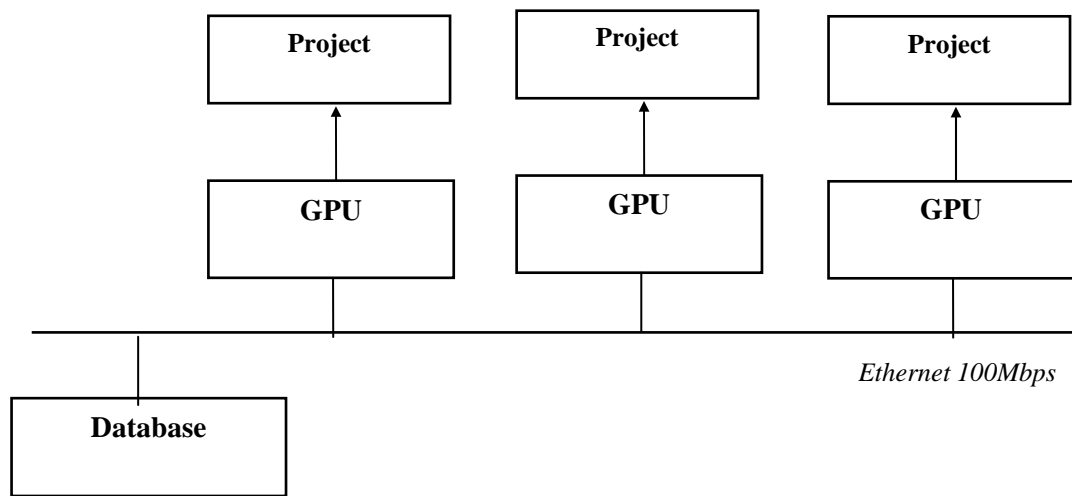


Figure 1. Hardware connection

### 3.3 Realtime Application Process

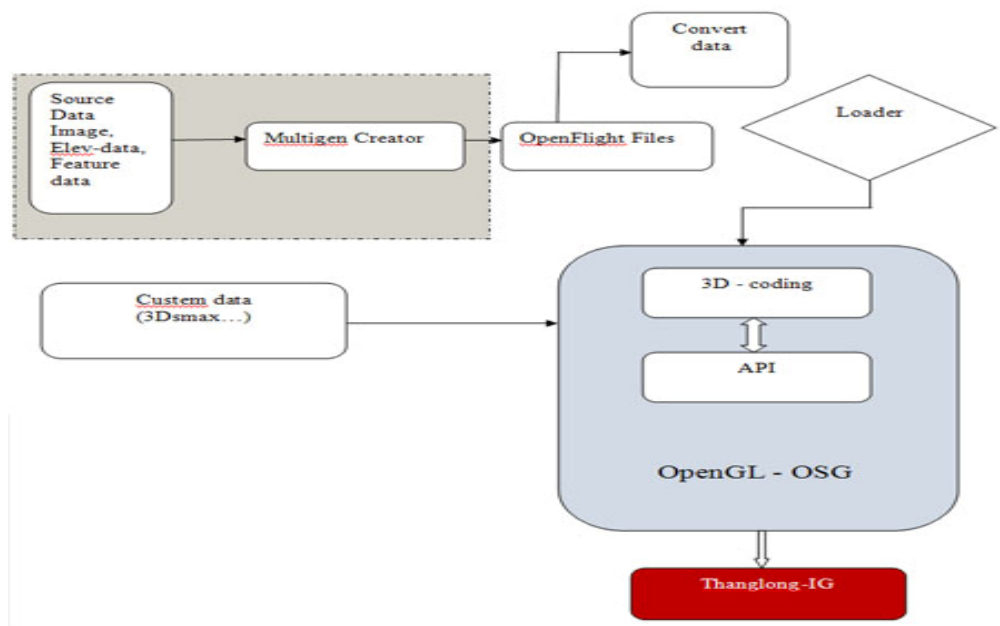
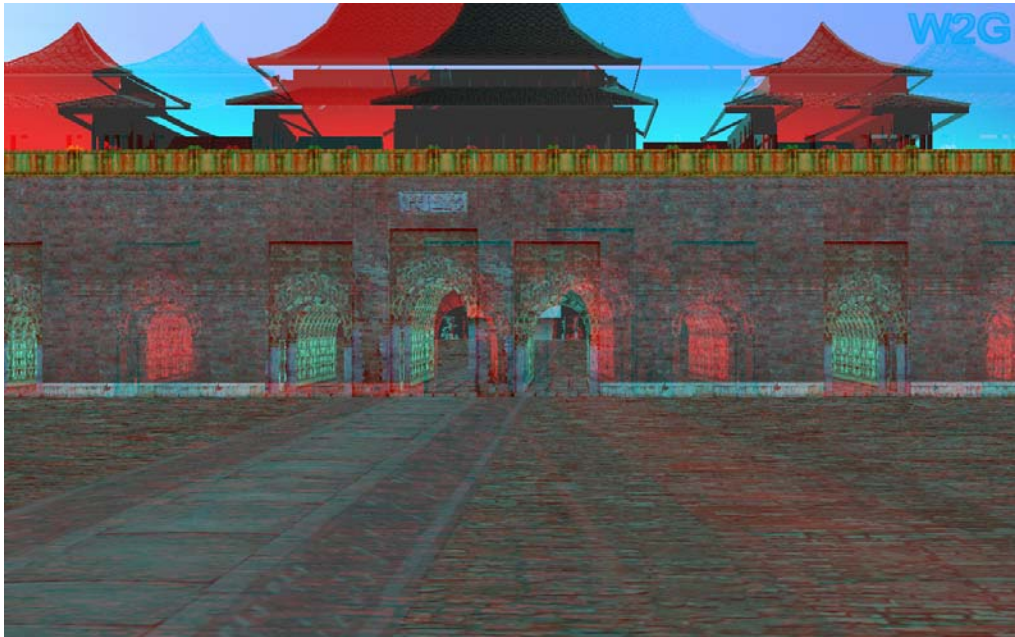


Figure 2. Realtime Application Process

### 3.4 Illustrations



**Figure 3. Image of Doan Mon which is reappeared in multi channel display mode to help image with depth**



**Figure 4. Image of Ngoc Son which is reappeared base on 3D graphic technique and virtual reality technology**



## **4. PRACTICABILITY AND APPLICATION REALITY**

### **3.1 Education Realm**

Now, products in general and software in particular which apply for Education in relic realms only by images, documents as handwriting. They dry and haven't taken for pupil A comprehensiv view about background, area and people in past.

For that reason, after products were completed, we will edit them to integrate in CD, DVD with user guide to attend to school in teaching History as Relic of Ancient Cham, Culture, people lived in Hanoi Ancient,...

It is seem tobe the product which has highly Educational in realm of history. People or users can contemplate and imagine about social view, deploiment of relic of dynasty with their own eyes.

Our products not only apply in CD, but also able to run online (this thing help somebody to learn e-Learning more easily ).

### **3.2 Tourism**

It will be images to popularize the images, tourism to tourist most effective. We can say that will be food for the mind to attract tourists from all over the world to visit our relics, famous landscape which are importance in our country.

### **3.3 Culture**

Before some difficulty of recreating relics as Hanoi Imperial Citadel, this thing will be an effective Solution. Though it not bring to the feel that "touch by hand, shake the forehead", but with those actual state, we should think that there are some work of relic of revolution on base of Kinh Thien Palace and it is also very precious because it was one-time of magnanimous of Vietnamese nation to bring about democratic revolution, for this reason it can be destroyed to recreate Hanoi Imperial Citadel. Virtual reality technology Solution apply in recreating some an important relic of old history, works of history will some extent supply documents by images, the faculty of being experienced in observing the past.

## **3. CONCLUSION**

Always taking pride in being a leader in the field of simulation of virtual reality in Vietnam, for the time being, the Centre is heading for the recreation of the entire images of the Old Quarter, the relics of ancient temples, pagodas, and Imperial City of Hanoi into an overall picture of the former imperial dynasties. This project has succeeded in providing a mode of observing the past by virtual reality technology, whereas the restoration of the relics as a whole will be very costly, time-consuming, or impractical.

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