

APPLYING AUGMENTED REALITY TO VISUALIZE THE HISTORY OF TRADITIONAL ARCHITECTURE IN TAIWAN

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ABSTRACT:

Many historical building which seems inherent knowledge in history, such as the shape or form of the building or the physical artefacts which people usually cannot aware and understand them. For instance, the pool in front of the house, interior configuration of building, and buildings decorations, etc, all these details with the historical significance of the humanities. Therefore, through the virtual interface to reveal those hidden knowledge in history, highlight the humanity value of its implication for education.

The virtual interface in this research is based on Augmented Reality (AR), which combines the virtual object in a real world. Augmented Reality can enrich a user's real environment by adding virtual objects to it. The goal of this study is to create the interactive environment for users to understand traditional historical architecture and its different cultural landscape in Taiwan. Through Augmented reality technology, users which had head-mounted displays (HMD) with built-in camera and connected to PC can visualize the historical architecture and provide an intuitive way for interacting between them. In this study, a traditional architecture, "Young's Ancestral hall" located in the south of Taiwan, will be used to construct this interactive environment. Hence, those spatial represent with cultural meaning, ontology construction pattern of architecture can be revealed their relevance between the economic and social environment in history.

1. INTRODUCTION

1.1 Historical Background: Yang Ancestral Hall

Most of Han people in Taiwan immigrated from South of Fukien and East of Kantung since the 17th century. Maintenance a memorial ceremony for ancestors became their long journey across the sea pursuing an original root. In this traditional concept, the Yang Ancestral Hall in Jidung was first founded in 1923, as studied in historical materials, the building was once destroyed by strong winds in 1950. It is fortunate that the Yang Ancestral Hall still preserves a lot of traditional architectural features and its surrounding environment as before.

1.2 Research Purpose

The Yang Ancestral Hall is one of the important household temples in Jidung, and is conceived on a completed scale. The building was composed by various parts add up to a satisfyingly harmonious whole.

1.2.1 Han's geomancy as holistic design theory: Han's geomancy is based on a holistic view of the cosmos seen as an integral part of a natural and its energy fields. It correlates many factors, such as landscapes, land forms, micro-climate, magnetic fields, solstices, lunar phases, and with the psychosomatic welfare of the human being. Indeed, it influenced not only the location and orientation of buildings in geographical space, but even governed the socio-culture of human beings in time. During the living time of owner who had built buildings within the *Yin* and *Yang*, which geomancy reflects a profound awareness of the ecological relationship between man and the forces of natural.

The geomantic correlations between the five elements (these phases were symbolized by the ideograms for earth, wood, fire, metal and water), and the four cardinal points, the four seasons, the four mythical heavenly animals (the Azure Dragon lived in a mountain stream in the east, the region of morning and spring, thereby represent the time of ascending *Yang*; the home of the White tiger lay on in the mountains of the west, the region of evening and autumn, which represent the time of ascending *Yin*; the Black Turtle was thought to dwell in the mountains of the north, the direction of midnight and winter, while the Red Bird resided in the plains of the south, the direction of noon and summer) and five solid bodily organs.

The implications of Feng-shui for the sitting of a building were varied, but they can be generally summarized as followings whenever possible: a) to face a southerly direction, toward the warmth of the sun and away from the wind; to sit with its back to a large hill with two smaller hills to either side, but no hill in front; to have some forms of water such as a stream or pond in front, but never behind. As to the Yang Ancestral Hall, its plan is laid out on a north-south axis with the building facing toward the south, according to an old Chinese manual of geomancy.



Figure 1. The Yang Ancestral Hall

1.2.2 Building Construction: Firstly, the planning of a traditional building is taking the process as a starting point. It describes in detail how a master carpenter uses a traditional special long rule for determining the measurement in cutting timbers into the shape of posts and beams to the appropriate size. Secondly, those works have been done from digging foundations to the assembling of timber frames, including both raising frames and related ceremonies. Thirdly, when the major finishings and decorations have done, the spaces between the exposed timbers had to be filled and many different kinds of infilling were used.



Figure 2. The Front Door of the Yang Ancestral Hall

1.2.3 House Form and Culture: The basic form of a traditional house is a walled enclosure surrounds one or more courtyards, in which the hollowness of the court gives a form and a place for the unity a family. The design of spatial organization is usually symmetrical in a general way, the central axis leading through the centre of the front wall, the lower building, the court and the higher building. In this idea, the main hall is located opposite the main entrance, facing to the main courtyard. The central space within this layout is usually this main hall, where the main ceremonies were held. In this large scale of a building site which had grown loosely in a lateral direction, the original series of central courtyards continue to be more public, but the private zones moved into less formal parts in the side areas or behind the main hall.



Figure 3. The centre within this ancestral hall is the main hall

In the whole, a traditional building fulfils its vision in a balanced, form-oriented style. The main hall, the focus of the family and the centre of the compound, always occupies the important position in the middle of a building facing out into a courtyard, which these courtyards adjusted well to micro-climate.





Figure 4. These yards adjusted well to climate

2. AUGMENTED REALITY (AR) TECHNOLOGY

Many computer applications have been developed for helping people to understanding of Traditional Architecture Building. Some of them failed due to without providing a quick and intuitive way for user visualization. This project utilized augmented reality (AR) technology to implement the 3D animated navigation for traditional architecture.

With improvement of technology, many computer technologies have been used to help people in the historical building restoration and preservation. One is using computer for the presentation of structural of architecture such as CAD/CAM applications. The other is form recorder of restoration and preservation in order to provide the future to research and repair it.

However, in the preservation of the traditional architectural 3D image, we are still short of appropriate tools. Cultural and historical researcher currently may use 2D or image method, to describe the building's architecture form and size. The problem of using this method is not suitable because it does not allow user browse the architecture intuitively and rapidly building components in three-dimension (3D).

Augmented reality (AR) technology might be a possible solution for Cultural and historical researcher. Since AR could combine real and virtual objects and interact virtual objects in real environments, it might be a powerful tool for people to visualize the history of traditional architecture.

3. OVERVIEW OF THE SYSTEM

3.1 System Goal

This study set up an AR environment for people to visualize the history of traditional architecture in Taiwan. The goal of the system is to utilize AR technology to preserve the image of traditional culture for field study. The Yang Ancestral Hall in Jidung was a good example to tested. This system includes the five difference 3D animation model to visualize the Yang Ancestral Hall, the component of the building attributes can be placed by different angle and show in the display. People can easily visualize the building's form and structure through manipulating physical marker.

In this system, total have five different themes to transmit the cultural meaning of traditional buildings. Figure 5 shows five topics and mapping cards.











	A	B	C	D	E
Card pattern					
Meaning	Building Ontology	Structural	Class status	Location	Yin and Yang
3D represented model					

Figure 5. Five topics of Yang Ancestral Hall

- A) About the Yang Ancestral Hall's main building.
- B) The whole space of buildings and the environment interact.
- C) The house space's rank relation and the use status.
- D) The live features of architecture principles in Taiwanese house.
- E) Feng-shui and Yin-Yang theory.

The system allows user to rotate the position of the components and observe the 3D image of architecture.

3.2 Scene Design and Layout

There have four graphic cards in the Figure 6 about the Yang Ancestral Hall's history status, and image pattern at the right side in order to generate the virtual 3D object image. This card can generated the architecture model, change the card will be corresponding to the content description.

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Yang Ancestral Hall

Historical Background: Yang Ancestral Hall

Most of the people in Taiwan migrated from South of Fujian and East of Guangdong since the 17th century. Most of them had ancestral halls. The Yang Ancestral Hall in Jidung was first founded in 1822, and started its construction in 1825. The building was reconstructed by Jidung in 1900.

It is fortunate that the Yang Ancestral Hall still preserves a lot of traditional architectural features and its surrounding environment as before.






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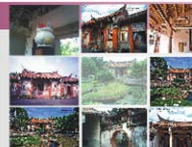

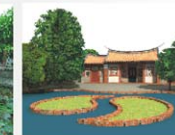

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Yang Ancestral Hall

Han's geomancy as holistic design theory

1.1. Han's geomancy is based on a holistic view of the cosmos as seen as an integral part of a natural and its energy fields. It considers any factors such as landscape, its relief forms, micro-climate, magnetic fields, energies, human phase, as well as the psychosomatic welfare of the human to be integrated, and influence not only the location and orientation of buildings in geographical space, but even generated the socio-culture of human beings in time. During the long time of Chinese traditional buildings as the Yin and Yang, which geomancy reflects a profound awareness of the ecological relationship between man and the forces of nature.

The geomantic correlations between the five elements (these phases were symbolized by the ideograms for earth, wood, fire, metal and water) and the four cardinal points, the four seasons, the four trigrams, the four mythical animals (the Azure Dragon lived in a mountain stream in the east, the red phoenix in the south, the white tiger in the west, the black tortoise in the north), the direction of morning and evening, the direction of rising and setting, the direction of the Black Turtle was thought to walk in the mountains of the north, the direction of rising and setting, while the Red Bird resided in the plains of the south, the direction of moon and sun and five solubility organs.

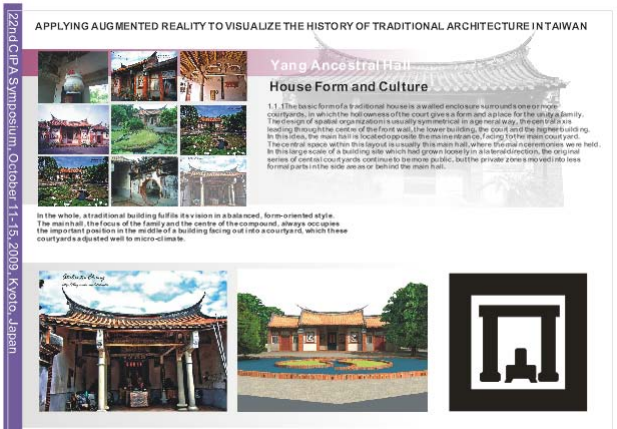
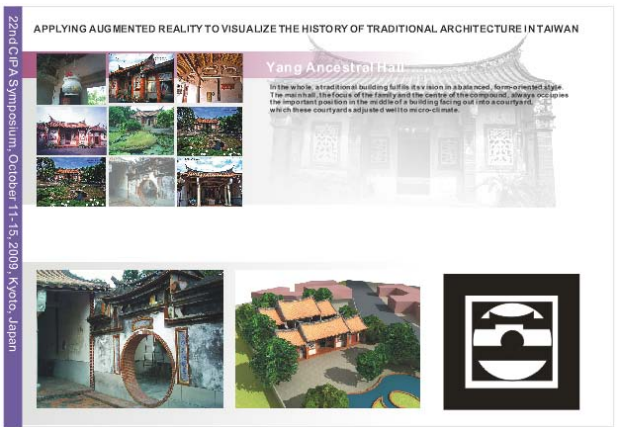


Figure 6. About Yang Ancestral Hall's content and the mapping pattern.

This project utilized AR technology to visualize the history of tradition architecture in Taiwan. The system transformed the 2D imaging preservation method into Real-time three-dimensional image rendering (Figure 7). It allows users directly understand the background culture of the building, and know the relationship in environment and people (Figure 8).

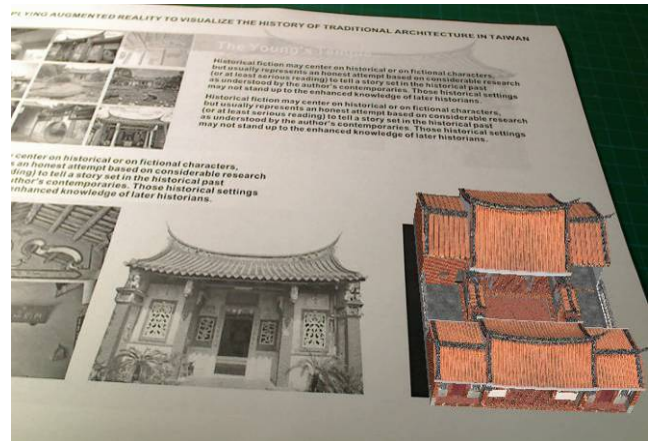
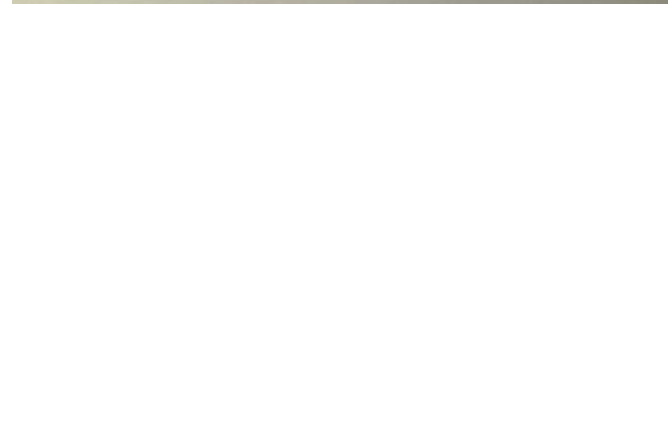
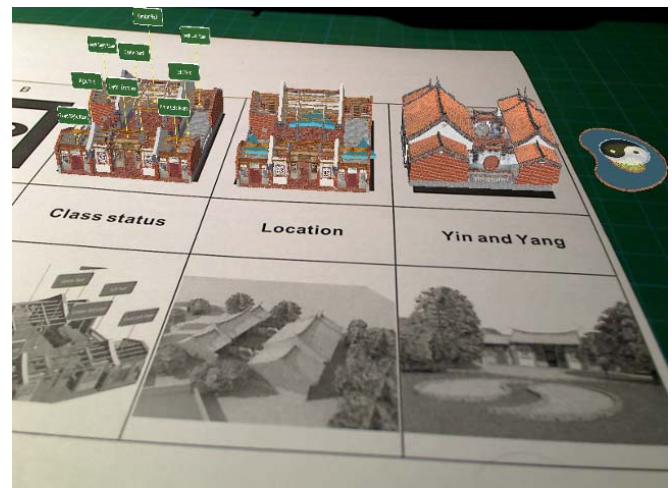
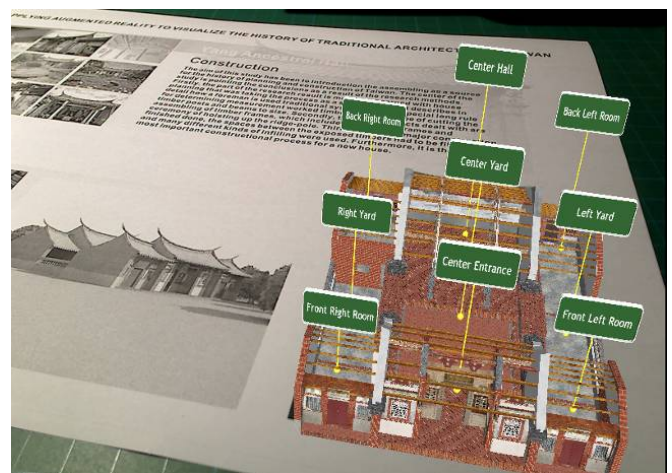
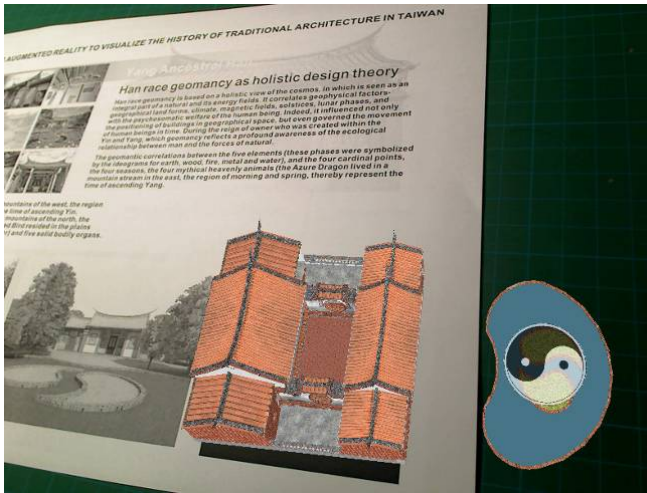


Figure 7. Real-time three-dimensional image rendering





has been implemented. Finally, the suggestions for future development of applications in historic building restoration and preservation.

This study is to create the interactive environment for users to understand traditional historical architecture and its different cultural landscape via AR environment. This projector were decorated as a magic-mirror which do make the interaction and interface more friendly to make people more immersive in the scenario of traditional architecture culture. On the other hand, by using AR techniques to produce these concept approach in the field of architectural conservation and will become an important reference point for conservation and maintenance of historical buildings in the future.

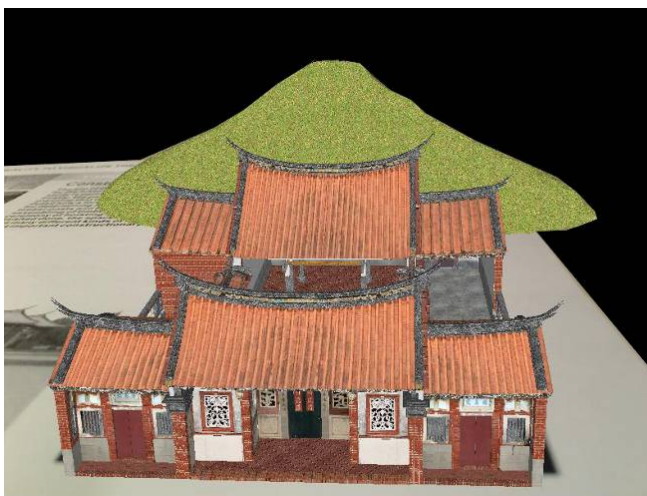


Figure.8 Use AR technology allows users read the content text and understanding structure of the architecture.

4. CONCLUSIONS

Two results have been obtained. First, using AR technology, the traditional historical building of Taiwan's culture has been transformed into visible virtual components and the relationships of the components are visualized. Second, a new and intuitive interaction method for historic building research