

Available online at <http://www.mecs-press.net/ijeme>

## Easy and Deep Media in Cultural Heritage Field

### —The Development of Mau-kung Ting Educational Media for the National Palace Museum

Chun – ko Hsieh<sup>1,2</sup>, Quo – ping Lin<sup>2</sup>, Chiung – yi Huang<sup>2</sup>, Chung – yi Chang<sup>2</sup>, Yen – ju Lin<sup>2</sup>, Yi – ping Hung<sup>1</sup>

<sup>1</sup> Graduate Institute of Networking and Multimedia, National Taiwan University

<sup>2</sup> National Palace Museum Taipei, Taiwan, R.O.C.

---

#### Abstract

This project intends to develop an effective educational media that is not only rich in cultural content but also feasible in the museum setting. We want to introduce the Mao-Kung Ting, one of the most valuable collections of the National Palace Museum, to the public in two key aspects—its aesthetic beauty as an antique bronze cauldron, and its historical significance of carrying the longest bronze inscriptions ever discovered among unearthed bronze in China, which has made it play an important role in the evolution of Chinese characters. Our mission is to develop an interactive installation that could help the audiences to understand this critical cultural heritage with ease. The major techniques that have been employed to facilitate this process include intuitive interactive interface, computer graphics animation, as well as an immersive environment with audio and video.

**Index Terms:** Chinese characters; computer graphics; animation; immersive; cultural heritage

© 2013 Published by MECS Publisher. Selection and/or peer review under responsibility of the International Conference on E-Business System and Education Technology

---

#### 1. INTRODUCTION

There has been a growing trend toward applying computer technology in the field of cultural heritage education. This study aims to develop an educational media system that the audiences could intuitively interact with while appreciating the sophisticated cultural content with ease. Ting, the type of bronze cauldron with three hooped feet, is a symbol of regime legitimacy in traditional Chinese culture. The Mao-Kung Ting is one of the most important collections of the National Palace Museum not only because of its symbolic significance in the history, but also because of the length of the inscription engraved on its interior, which is the longest ever discovered among unearthed bronze. Writing characters play a significant role in supporting the cultural continuity. The creation of Chinese characters, although later than that of the Egypt and Mesopotamia

---

This work was partially supported by National Science Council NSC97-2218-E-002-002.

\* Corresponding author.

E-mail address: d94944001@ntu.edu.tw, {jameslin, choneyi, johnnyc, yenju }@npm.gov.tw, hung@csie.ntu.edu.tw

cuneiform writing, generally believed to have started at least three thousand years ago. As a living language that is still being used by over a billion people thousand years later today, it goes without saying that the Chinese characters is one of the most precious cultural assets for the mankind. Earlier Chinese characters are mainly the “Oracle” engraved on tortoise shells and animal bones and the inscriptions on the cauldrons. On the study of the cauldron inscriptions, however, it could never be thorough enough without mentioning the Mao-Kung Ting. In view of the historical as well as the cultural significance of the Mao-Kung Ting, our team endeavored to combine the historical content of Mao-Kung Ting with the evolution of the Chinese characters.

By employing inter-disciplinary methodologies, we have developed a set of intuitive interactive installation that emphasizes on both the historical content of the Mao-Kung Ting and the evolution of Chinese characters through an immersive audio and video environment. This educational media system aims to provide the audiences an engaging and in-depth interactive experience. The design concept is therefore audience-centered that we want to make the installation: on the one hand, easy for the audiences to get involved without being superficial; on the other hand, rich in deep cultural content without being abstruse to the general public. The system is composed of two applications: the “Turning Rust into Gold” application and the “Interactive Chinese Characters” application. The “Turning Rust into Gold” application is a prior work of our research team [1]. It aims to translate the macro concept of space and time that the Mao-Kung Ting has traveled through in the past 3000 years into a virtual experience of de-/weathering. By visualizing the de-/weathering process, we also try to convey the importance of the cultural heritage preservation. The Interactive Chinese Characters application demonstrates the evolution of the Chinese characters from ancient pictographic characters to modern fonts. Exemplified by sets of individual evolution of ancient Chinese characters, the goal of the installation is to make the user feel like being in the time tunnel witnessing the evolution of Chinese characters from the oracle bones, cauldron inscriptions to seal script, official script, and regular script to cursive fonts. It aims to guide the audiences’ experience from understanding of changes in shape of the Chinese characters to appreciating the beauty of Chinese calligraphy. The ultimate mission of the system is to interpret the development of Chinese characters across time and space into a joyful visual presentation that further provokes users’ curiosity about the ancient Chinese characters. The appearance of the installation is shown in Figure 1 and the interaction between the user and the installation is demonstrated in Figure 2.



Figure 1: The appearance of the Interactive Chinese Characters installation



Figure 2: The interaction between the user and system.

## 2. Related work

### A. *De-/weathering Simulation*

The daylight, in conjunction with the effect of temperature, moisture and atmospheric oxygen, acts as the main parameters of outdoor weathering. The visual simulations of time-variant material appearance are rendering by computer graphics approach. In this work, the “Appearance Manifolds” (Figure 3) simulation technique has been chosen. A weathered material sample contains spatial variations that depicts different degrees of weathering can further be analyzed to extract spatial and temporal appearance properties for synthesizing the weathering process. The basic idea is that the spatial variations in the appearance of a weathered material sample at a given time will correspond to different degrees of weathering [2].



Figure 3: Weathered appearance manifold: “Modeling the time-variant surface appearance of a material from data captured at a single instant in time [2].”

### B. *Breath-based Biofeedback*

Several techniques for sensing breath status were surveyed. Optoelectronic Plethysmography (OEP) is a method to evaluate ventilation of the chest wall surface motion through an optical movement detecting system. It requires several small reflective markers to be placed on the thoracic-abdominal surface by adhesive tape. Heart Rate Variability (HRV) is a physiological phenomenon where the time interval between heart beats varies. It is measured by the variation in the beat-to-beat interval. Respiratory Inductive Plethysmography (RIP) is a tool for ventilatory monitoring, measuring changes in rib cage and abdominal cross-sectional areas, it is a

traditional breath detection method to detect respiration status of users [3, 4]. Ultra Wide Band (UWB) radar with IR laser diode can remotely measure the heart activities and respiration of the users [5]. As it is non-invasive, it does not require attaching a device to the body, which is comparatively more feasible in the museum setting. As a result, we have chosen the UWB to detect the breathing status of the users. Table 1 shows the comparison of these respiration detection methods [6].

Table 1. Comparison of Respiration Detection Methods

	<b>OEP</b>	<b>HRV</b>	<b>RIP</b>	<b>UWB</b>
Attached to body	Attached markers	Attached to skin	Attached to body	<b>Non-invasive</b>
Accuracy	High	Median	Median	<b>Median</b>
Limits	Least mobility	Detectors attached to fingers	Detectors attached to the body	<b>Less mobility</b>

### C. Research on Chinese Characters

Back in about 100 A.D., the first dictionary in China titled *Shuowen Jiezi* is composed by Xu Shen, an Eastern Han Dynasty Scholar. It summarized the six categories of the creation of ancient Chinese characters including Pictographic Characters, Indicative Characters, Associative Compounds Characters, Pictophonetic Characters, Mutually Explanatory characters, and Phonetic Loan Characters. Since Song Dynasty, the literati have been fascinated with the beauty of ancient bronze such as the cauldrons and the bells. The appreciation of the bronze has further drawn the literati’s attention to the ancient Chinese characters engraved on the bronze cauldrons and bells—the cauldron inscriptions. Hundreds years later, scholars and literati in Ching Dynasty began concentrating on the oracle bones and the bronze inscriptions. After a great amount of research has been done by the scholars, various dictionaries have been composed as valuable supplements for research across disciplines.

With the advancement of modern technology and information system, researchers have put a lot of effort to integrate multiple resources of the Chinese characters. To date, several digital archives for ancient Chinese characters including the oracle bones and the cauldron inscriptions have been built, digitalizing thousands of inscriptions of ancient Chinese characters to be accessible to researchers [7].

## 3. The Turning Rust into Gold application

The “Turning Rust into Gold” application is our prior work. It aims to integrate modern technologies and aesthetic design to reveal the unique features of the Mao-Kung Ting. The users will be guided across the spatiotemporal civilization in China to experience the Chinese philosophy. The application integrates the digital simulation of the de-weathering processes with the human interactive interface that uses a breathing-based biofeedback to signal the simulation process. The metaphor of “Qi”, which refers to the energy flow of living beings in the world, is thus converted into the nature breathing process.

### A. System architecture

The interactive installation consists of a detection module and a display module. The main component of the detection module is the Mao-Kung Ting-shaped chair embedded with a UWB breath sensor and pressure sensors inside. When a user sits on the chair, the pressure sensors will sense the weight of the body.

Meanwhile, the UWB breath sensor will start to detect the breathing frequency of the user. The display module, on the other hand, is composed of two display components: the primary display and the secondary display as shown in (Figure 4). The 52-inch touch screen TV as the primary display in the front is arranged to articulate the process and to provide related information. The secondary display comprises a large projection area with multilayer veils and a Mao-Kung Ting-shaped chair.



Figure 4: The installation has a primary display and a secondary display.

#### *B. Interactive scenario*

The designed scenario could be separated into two stages. In the first stage, the users will be asked to adjust their breathing frequency. As soon as they have accumulated energy from their breathing practice, they will be guided into the second stage, in which they could have the power to turn the rusty Mao-Kung Ting into its original golden appearance through the haptic interaction, which we called a de-weathering process. The immersing environment we designed with the application of “Turning Rust into Gold” is shown in Figure 5 [1].

#### **4. The interactive chinese characters application**

Another important feature of Mao-Kong Ting is the inscriptions engraved on its interior. These ancient characters



Figure 5: The immersing environment designed with artistic atmosphere and Chinese cultural elements.

could hardly be understood by modern audiences without sufficient guidance. The Interactive Chinese Characters application is created in order to arouse viewers’ interest in appreciating the ancient inscriptions. With the support of innovative multi-media presentation as well as the intuitive multi-touch interface, these

ancient characters are animated to interact with the users. They demonstrate their individual evolution through visual presentation that the users can interact with. Our goal is to inspire the modern users by offering them a new experience with the Chinese characters.

#### A. System architecture

The main structure of the installation is divided into the display module and the detection module. A 42-inch touch screen is designated as the primary display device and the detection device. Three projectors installed on the ceiling are the peripheral display device, which generates the surrounding image. The structure is shown in Figure 6.



Figure 6: The main components of the installation: the Primary Display Module, and the Peripheral Display Module.

#### B. Interactive scenario

1) *Magic Lens*: The magic Lens is a designated selection area that functions like a magnifying glass. The participants could use their finger tips to manipulate the Magic Lens on the screen intuitively. Instead of magnifying the image underneath it, the Magic Lens will simultaneously convert the ancient inscriptions into modern characters when the users direct the magic lens to the position desired, as shown in Figure 7.

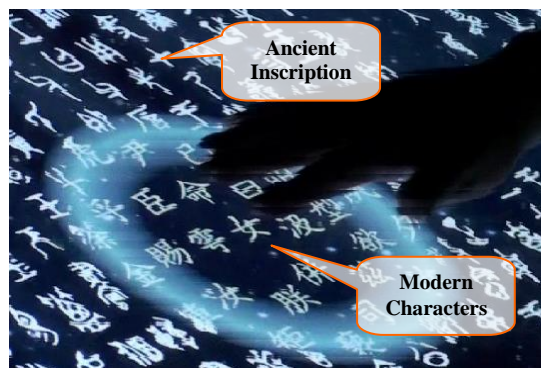


Figure 7: As the users direct the magic lens to the position desired, the Magic Lens will simultaneously convert the ancient inscriptions into modern characters.



2) *Seamless Connection*: Seamless Connection suggests two aspects of the interpretation on each Chinese character, the formal aspect and the affective aspect, that are made possible through the cooperation of the Primary display and the Peripheral display. The affective aspect refers to the continuity of the plot that seamlessly connects with the audiences' daily experience. Take the character “自 (Zi)” for example, to demonstrate its creation and evolution, we created an animation of Sun Wukong (i.e. the Monkey King in the Journey to the West) who is pointing to himself to show the inspiration of the creation of the character “自 (Zi)”. When the Gold-Banded Cudgel in the Primary Display is thrown by Sun Wukong, it will be picked up right away by another Sun Wukong in the Peripheral Display, as shown in Figure 8. It is designed not only to catch the users' attention but also to suggest that the development of Chinese character is intimately linked to our daily lives.

The formal aspect of the seamless connection, on the other hand, refers to the seamless connection within the evolution of each character. To further demonstrate the formal evolution of the character “自 (Zi)”, while the performance followed goes around the Peripheral Display, the Primary Display will simultaneously present the historical changes in the form of “自 (Zi)” from ancient pictographic characters to bronze inscriptions, seal script, official script, regular script, cursive fonts, and other stages. This consecutive animation therefore manifests the seamless connection between each form of “自 (Zi)” historically, as shown in Figure 9.

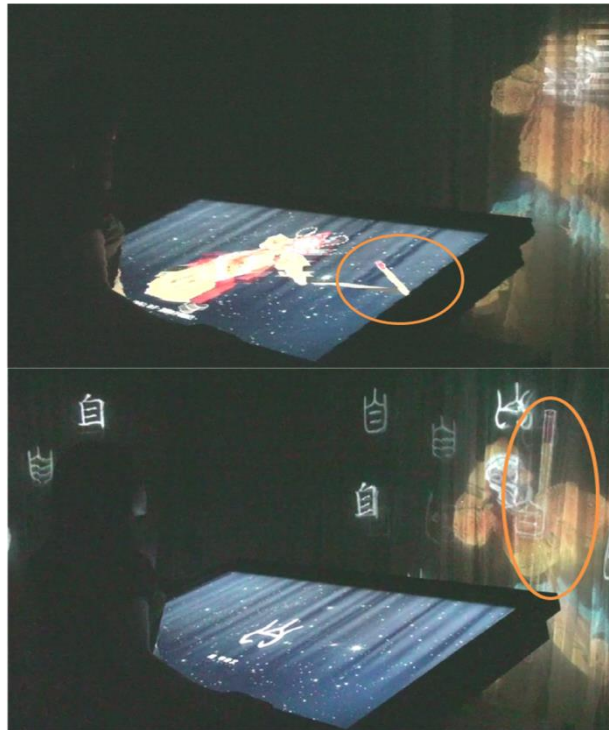


Figure 8: The Gold-Banded Cudgel in the Primary Display thrown by Sun Wukong, as shown in the upper image, will be picked up right away by the Sun Wukong in the Peripheral Display, as shown in lower image.



Figure 9: The evolution of the Chinese character “自 (Zi)”, which means “self” in Chinese, from an ancient Pictographic Character to a modern Phonetic Loan Character. It was originally a Pictographic Character as a representation of the nose. Then, since people usually point to their nose to express themselves, this character is later borrowed to signify a person self-identification. As time goes by, the form of “自 (Zi)” gradually evolved from bronze inscription to the modern regular script that indicates the concept of “self” as shown in the figure.

## 5. conclusions

The Mao-Kung Ting Educational Media has utilized two new media applications: the “Turning Rust into Gold” application and the Interactive Chinese Characters application to interpret the precious state vessel Mao-Kung Ting into an engaging and in-depth interactive installation. While the “Turning Rust into Gold” application has translated the space and time that the Mao-Kung Ting has traveled through into a virtual experience of de-/weathering, the Interactive Chinese Characters application has visualized the evolution of the Chinese characters from ancient characters to modern fonts. In addition, the immersing and contextual environment of the Chinese aesthetic atmosphere has creatively provided a sensational experience of crossing time and space through Chinese civilization. The installation has been exhibited in the traveling exhibition, National Treasures of NPM in Chiayi, at the Museum of Chiayi City for 2 months. It has been observed that it has effectively engaged people of different ages. It has provided visitors new approaches and perspectives to appreciate ancient artifacts and has further provoked their curiosity about the evolution of Chinese characters. In sum, this installation has successfully translated deep cultural knowledge into an easy-to-understand interactive educational media. It has also contributed to the feasibility of integrating new media art in Cultural Heritage Field.

## ACKNOWLEDGES

We would like to thank EECOM Multimedia Co., Techart Co Ltd, Microsoft Research Asia, Academia Sinica, Industrial Technology Research Institute (ITRI) and curators of National Palace Museum. We would also like to thank I-Ling Liu for her contribution in compiling the materials.

## References

- [1] Chun-Ko Hsieh et al.,” **Turning Rust Into Gold: An Ancient Artifact As An Interactive Artwork**,”In Workshop on Interactive Multimedia Installation and Digital Art, Singapore, July 2010.
- [2] Jiaping Wang et al, “Appearance Manifolds for Modeling Time-Variant Appearance of Materials. ACM Transaction on Graphics Vol. 25, No. 3, 2006.
- [3] Meng-Chieh Yu, Yi-Ping Hung, King-Jen Chang, Jin-Shing Chen, Su-Chu Hsu, Ju-Chun Ko, Ching-Yao. Multimedia Feedback for Improving Breathing Habit. 1st IEEE International Conference on Ubi-media Computing (U-Media 2008), Lanzhou University, China, July 15-16 , 2008.
- [4] Hoyer, D., Schmidt, K., Bauer, R., Zwiener, U., Kohler, M., Luthke, B., and Eiselt, M. Nonlinear analysis of heart rate and respiratory dynamics. IEEE Eng Med Biol Mag., 1997.
- [5] Igor Y. Immoreev. PRACTICAL APPLICATION OF ULTRA-WIDEBAND RADARS. Ultrawideband and Ultrashort Impulse Signals , Sevastopol, Ukraine, September 18-22, 2006.



- [6] Chun-Ko Hsieh et al., "Transformational Breathing between Present and Past: Virtual Exhibition System of the Mao-Kung Ting," MMM 2010, Jan 6-8, 2010.
- [7] Digital Archives of Oracle Bones Rubbing,  
[http://ndweb.iis.sinica.edu.tw/rub\\_public/System/Bone/home2.htm](http://ndweb.iis.sinica.edu.tw/rub_public/System/Bone/home2.htm)

**How to cite this paper:** Chun-ko Hsien, Quo-ping Lin, Chiung-yi Huang, Chung-yi Chang, Yen-ju Lin, Yi-ping Hung, "Easy and Deep Media in Cultural Heritage Field—The Development of Mau-kung Ting Educational Media for the National Palace Museum", *IJEME*, vol.3, no.2, pp.26-34, 2013.