The Establishment of an AR-based Interactive Digital Artworks

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Abstract—This work attempts to declare the background of personal contemporary state through an immersion of “digital vacancy”. The work is stacked on the identical digital space with concurrent portrait and enjoyment. Moreover, the work describes the doubt and depression in life, combining with humor of predicament and absurdities of senses. We employ augmented reality to create digital artworks to present interactive poems. This work is established where the digital poem is generated via the interaction between a video film and a text-based poem. After establishing the digital artwork, we exhibited the digital work at Digital Art Center (DAC), Taipei, Taiwan. The audiences can interactive with digital poem in real time. In comparison to the other AR equipment, the cost of this work is quite low. In the future, some usability evaluation will be performed on this work.

Keywords—Augmented reality, Digital artworks, Interactive poem.

I. INTRODUCTION

In the past, the artists present the creation of domain and private space. The most artworks are based on non-interactive visual creative expression. With the progress of information technology development, people can create art by using the digital multimedia rather than just doing in a traditional manner. That is, the way of art-creating has changed dramatically. Thus, the digital art creation becomes more lively and interesting. Furthermore, these materials/technologies enhance the artists’ creativity. Artists are able to create artworks via technology and multimedia; that is to say, they can create artworks with the multimedia besides the traditional way of creating arts, so they can create in more fashions to express their thoughts. Today, the ideas of artists can be implemented in real time via the powerful computation abilities of various computers. The process of artworks creation is charmingly. Because it no longer a phenomenon of the slice, but a manifestation of the experience. Interaction has been considered as an important characteristic of digital artworks. But the evolution of the aesthetic point of view is seldom mentioned. Participate in the experience during the construction is the significance of create all of the works. It formed the “interactive aesthetics” gradually. These are important concepts in new media art [1][2].

In “The End of Art”, Arthur C. Danto said/mentioned that the function of art imitation and reappear has already disappeared. From now emphasizing that the verisimilitude imitation is also redefined in the art history [3]. The text should be opened to and created by the readers. The meaning of text is interpreted by the readers instead of the author. This is the well-known “writable text” concept [4].

In this work, we will employ Augmented Reality (AR) technology to create digital artworks to present a series of interactive poems. The audience can interact with the digital poem via pre-designed postcards. Notice that the postcard is real object, while the digital poem is virtual sight. Interestingly, the real lies in the virtual; vice versa, virtual scenes render in the real environment. Therefore, audience can feel themselves in an environment, both virtual and real.

II. RELATED WORK

In recent years, many scholars and institutes have been carrying out the research on Augmented Reality, one of the techniques of computer vision application. AR is also called Mixed Reality (MR), the extension of Virtual Reality (VR). By setting up the scene via Computer Graphics, VR can simulate objects in the real world and create the environment where users can interact with the simulated objects. AR is the images, objects or scenes generated by the computer that blend into the real environment to strengthen our visual feelings. In sum, it adds virtual objects to our real environment. The technology has to possess three qualities, the combination of virtual objects and the real world, real time interaction, 3D space only.

Fig.1. Reality and Virtuality(RV) continuum

Milgram et al. [5] treats the real environment and the virtual one as a closed union. We can find it in Fig 1. On the left side is merely real environment while on the right side is only virtual environment. VR is inclined to take place of the real world; AR is to augment the virtual image produced by the computer to the real environment. Presently, AR is being applied very extensively to such as education, medical technology, military training, engineering, industrial design, art, entertainment and so on [6][7][8][9][10][11][12]. AR combines virtual objects with the real environment and displays the virtual object generated by computers in front of users’ eyes. Milgram et al. [5] defines two displaying ways of AR. One is See-Through AR. Users can directly see the surrounding environment through the monitor and the monitor also display the virtual image in it. Accordingly, the
effect of augmented environment can be the greatest via See-through AR. The other is Monitor Based AR. The computer combines the images captured by the webcam with the virtual images. The final image after combination will show up on Head Mounted Display (HMD) or computer monitor. There are two kinds of HMD, one is pure HMD and the other is HMD with a small webcam. The former has small volume and can be equipped with the head mounted tracking instrument, which can track the present angle as well as direction ahead of user’s head. It is more suitable for research and application of AR. The latter has immersion effect.

III. CONCEPT OF WORK

This work attempts to declare the background of personal contemporary state through an immersion of “digital vacancy,” the work is stacked on the identical digital space with concurrent portrait and enjoyment. The author allows the audience to generate engagement of ideas from past created videos and poetry using interactive media, which further pushes the audience to wonder what they are expecting and the kind of attention they involve in while waiting. Such as life, the crowd passes each other in the city, alternating and switching consciousness and predicament. Perhaps the image of dust generally contains an ingenious meaning due to naturally-born vision and wisdom; while the condensation of air, image and signs symbolize the endless vacancy. Perhaps the audience has fallen into a conventional mindset. Often times, the audience needs to think again before understanding the definition to his or herself.

Our thinking can be both naive and profound. Therefore, this work attempts to expand fragments of a series of identity from the phenomenology of inconspicuous things. The work describes the doubt and depression in life, combining with humor of predicament and absurdities of senses. We are the city wanderers who observe various surrounding symbols through constantly muttering without probing into its significance.

After we enter the kingdom of other dimension, we often start immersing in the beauty of ambiguity while thinking about the multilevel of possibility. Such pattern forms cognitive approach to reflect the nature and details of things, while estimating the length and scale of seemingly familiar yet strange surrounding sceneries, giving a little taste of such inspiration. As Claude Levi-Strauss said, “Our eyes have lost the ability to distinguish and we no longer know how to treat things.” Subjective regularity helps us gain insight to streamer and freeze in true cleverness. Our creation no longer belongs to part of theories and we can unlimitedly slow down our pace.

IV. DIGITAL POEM

A system (written in the Processing programming language) is established where the digital poem is generated via the interaction between a video film and a text-based poem. In other words, the system acquires two kinds of inputs: (1) a video file which was produced by the artist before, and (2) a modern poem which was written by the artist. The poem consists of a sequence of Chinese characters. Fig. 2 is the transformation program written in Processing.
After these two inputs are fed to the system, each frame in the video is transformed to an image constructed by texts. The transformation process is depicted as follows. A “cell size” is defined in the program, and each cell contains several pixels, for example, four pixels. The number of the cell size determines the style of the resulting image. For each cell in the frame, we replace the content by the character in the poem. The orders for the characters to be applied depend on their positions in the poem.

Moreover, the color of the character is based on the color of the cell on the same position. Notice that the font size of the character can also be defined by the designer. Therefore, if the font size is larger than the cell size, characters on the image may overlap with each other’s so that the colors will blur to embellish the frame to be “draw-like”.

When all the frames are generated and be filled with colors via the above process, an interactive “digital poem” with a video form is thus produced. Fig. 3 is the video file before transformation, play with Quick Time. And Fig. 4 is the frame after transformation.

Fig. 3. The video file before transformation.
V. IMPLEMENTATION

We create digital artworks to present interactive poem by taking advantage of the Augmented Reality technology. This work is implemented in Processing programming language and developed based on ARToolKit [13]. Figure 5 depicts the flowchart of digital poem presentation.

Fig.4. The frame after transformation (Pixels in this frame were replaced by texts in poem).

Fig.5. The flowchart of digital poem presentation
The webcam captures video of the real world and sends it to the computer. The system searches through each video frame for any square shapes of black color. If a square is found, the system uses some mathematics to calculate the position of the webcam relative to the black square. Once the position of the webcam is determined, a film of digital poem is drawn from that same position. This film of digital poem is drawn on top of the video of the real world and so appears stuck on the square marker. The final output is shown back, and displayed via the projector. Therefore, when the audience looks through the display they see film of digital poem overlaid on the real world.

Figure 6 shows the digital poem presentation based on our system written in Processing language. We create image textures and corresponding vertices. Then, the four vertexes of film will match the four ones of Image Texture and film will be drawn on the Image Texture. There are four vertexes in Image Texture. They are expressed as vertex (x, y, u, v). The x is coordinate of the vertex, the y is coordinate of the vertex, the u is horizontal coordinate for the texture mapping and the y is vertical coordinate for the texture mapping.

![Image](image.png)

**Fig.6. The film draws on image texture.**

About the development environment, we use a PC with Pentium(R) Dual-Core 2.6GHz CPU, Logitech Orbit as the webcam, which captures 30 frames per second. The frame size is 640×480. The distance between the webcam and the postcard is 50 centimeters. The AR marker on postcard is 4.55 cm in length and width respectively.

The interactive content of the work contains video. Each poem from postcard matches a virtual digital poem. Then, the audience can interact with postcard by directly manipulating it. Figure 7 is the example of postcard. Each postcard corresponds to a video of digital poem. The total numbers of postcards and videos are both 12. Shown in figure 8 are all of the 12 postcards.

![Images](images.png)

**Fig.2. (1) The postcard of back is AR marker. (2) The postcard of front is poem**
第二天上演的情節

無從界定
對此，以及其他人
這兩位在一定時間內的共同生活
（在某次外出時將選定的共同生活）
「探討」，
均有這樣的經驗和體會，
十分難忘。
近來的這種體驗和體會，
使我感到非常快活。

然而，對於未來的共同生活，
我漸漸感到有些遺憾。
也有些顧慮，
因為過去所接受的教育和訓練，
使我在許多年中
過於習慣於個人主義。
不修邊幅

書法之中，翰墨的運用必須著重細節。

章法的構成也是如此。

自古以來，書法家們一直在追求著書法的流暢和

書法的精妙。

簡單來說，書法就是一種通過筆墨的運用，

來表達出作者的情感和思想的藝術形式。

停格之二

然而，書法並非僅僅是表達情感的工具。

它還可以通過不同的筆法和字體，

來表現出書法家的個性。

所以說，書法準確而嚴格地

重要的因素。

中傷話

因此，書法家們在追求著書法的流暢和

書法的精妙。自古以來，書法家們

一直在追求著書法的流暢和

書法的精妙。然而，書法並非

僅僅是表達情感的工具。

它還可以通過不同的筆法和字體，

來表現出書法家的個性。所以

說，書法準確而嚴格地

重要的因素。
Fig. 8. The total postcards
The element of presentation includes the webcam embedded to the lamp, reading-desk, projector and white wall in exhibition. Figure 9 is the presentation of artworks. There are several postcards on reading-desk and the lamp is installed at a higher position in order to present a broader view. The audience “read” the content of these poem by manipulating the postcards, so that the digital films “hidden” behind the AR markers will be displayed. The installation of this artwork is show in figure 10.

Fig. 9. The presentation of artworks

Fig. 10. The audience interacts with AR digital poem.

VI. CONCLUSION

In this work, we employ augmented reality technologies to create digital artworks to present interactive poem. The artwork setting and operation is easy. Audiences only need to set up a webcam, with no additional hardware requirement. In comparison to other AR equipment, the cost of this work is quite low. In the future, some usability evaluation will be performed on this work.

III. REFERENCES