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Study on Flip Display Interface for Digital Signage

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Abstract

The purpose of this paper is to develop the digital signage interface of Korea Cheomseongdae (observatory) based on flip display regarding producing participatory digital signage along with necessity of development for new type of signage in digital signage market, in accordance with expanding the future display industry. In this paper, we develop UI/UX, binarization image processing and leap motion software to implement a variety of contents in the flip display sculpture like Cheomseongdae by leveraging leap motion devices which respond to touch display as NUI in UNITY3D environment and the user's hand gesture. We designed a dual window display which data is transferred to both the touch display available to be selected by user and the flip display of Cheomseongdae. In this process, binarization image processing and leap motion recognition processing software were developed and applied to the flip display. The variety of contents with binarization processing can be created and applied to the flip display. The flip display for digital signage can be installed in more various place if we develop the software for people to enjoy it simultaneously.

Key Words: Digital signage, flip DISPLAY, UI/UX, NUI, leap motion.

1. Introduction

The digital signage that ICT technology and contents were converged is composed of the digital signage market in the media from the view of cultural appreciation by building the converged platform of art and technology such as large-scale kinetic outdoor sculpture with type of pin toy, flip-dot display, block display and kinetic art display. This trend is evolving into the personalized service that allows users to interact with the media through online and offline experience beyond simple advertisement display or information offering in the past. According to the Revitalization Measure for the Digital Signage Industry of the Ministry of Science, ICT and Future Planning in 2015, the market size is expected to grow from $15.1 billion in 2014 to $31.4 billion by 2020, and domestic production is expected to grow from 1.9 trillion won at a CAGR of 13.4% in 2014 to 4 trillion won in 2020[1]. The development of smart digital signage which space, people, people and media are organically linked to provide users with new experiences can be a next-generation strategic industry that will lead the activation of future display industry and advertisement industry including high added value of ICT. This study is to develop and apply the flip display based on the interface for producing 'Digital Signage of Cheomseongdae' which is a symbolic sculpture of Korea. Besides, as a gesture and touch-based Natural User Interface (NUI) is applied to bring out the natural communication between the digital Cheomseongdae and audience, we intend to develop the participatory digital signage interface that significantly enhances the meaning of existence as an interaction with a user rather than simple display type display.

2. Flip Display based on NUI

In general, flip display technology is one of the display methods that can produce text or images as shown in Fig. 1 through flipping and back and forth the disk with reversing the current under the disk. Mechatronics technology which is the basis of flip display has been applied for a long time in flip display part since element technology such as electronics, mechanical design, control, embedded system and SI are converged together[2,3]. In recent year, there has been a growth in application technology that provides functional and unexpected pleasures in combination with interactive contents such as utilizing the physical movements of audience as shown in Fig. 2 in real time rather than simple display method. At present, the most representative company is ALFA ZETA[4] a Polish company which has been a global leading research and development, production company with customers in more than 50 countries around the globe when it comes to flip-dot since 1988.

Figure 1: Flip-dot Display by Alfa-Zeta

Figure 2: Flip-dot Display by Breakfast

Breakfast[5] , a company specializing in the research and development of physical displays located in the United States is also a specialized R&D company regarding patent licenses business, development of prototypes, and support of mass production. It is characterized by its own brand "ELECTROMAGNET DOT SCREEN" in terms of flip-dot. James said about works installed by the Breakfast at Manhattan's Herald Square, “the team at BREAKFAST re-engineered these components from the ground up, enabling them to operate in real-time and 15 times faster than originally designed. Users are not only able to see a unique black-and-white reflection of their movements, but hear what that sounds like as the thousands of analog dots spin rapidly back and forth[6]” . As the above works, the implementation of NUI interface such as user 's movement or touch can be an important factor to show technical and artistic characteristics of flip display. Wigdor defines that natural user interfaces (henceforth NUIs) are user interfaces which are natural in the way users interact and feel when using them[7]. NUI-type flip display can provide people with intuitive, non-repulsive, natural communication and enjoyment. The In Your Face’s work which was launched at CES in 2015 through a collaboration between ooVoo and Affectiva in Fig. 3 creates a personalized interactive wall with appearing laugh or skull through detecting and sending the information of the audience’s face by the Prime Sense depth camera installed behind the flip display wall[8].

Figure 3: Interactive Flip-dot Wall by ooVoo

The user centered flip display design has the advantage that can communicate with the device naturally depending on individual's intention and experience its pleasure. The purpose of this study is to install digital sculpture model based on flip display, which enables the user to enjoy the history and symbolic meaning of Cheomseongdae, choosing viewing the binarized images about Cheomseongdae, or responding to the hand gesture of the user, or naturally leads to an interest in the history and meaning of the sculpture through the interface development that provides experiences such as clearing off text or fallingstar.

3. Flip Display Interface Design for Producing Digital Cheomseongdae

The entire development solution for this study is shown in Figure 4. Cheomseongdae digital signage has three contents that user can choose. It consists of two binarization image contents for the history and symbol of Cheomseongdae, and interactive contents that reacts to the user's hand gesture in real time. The users choose the desired contents in the touch monitor and the input value is transferred to the main board. The transferred image content data is shown after transferring to the flip display through binarization processing with 0 and 1. In case of interactive contents using leap motion, they are implemented to be responded in accordance with the user's movements by detecting the shaking motion for the intuitive use of the user. We used leap motion to make use of hand gestures, the most natural communication of human beings in everyday life. Ghotkar and Kharate explain hand gesture recognition is the most easy and natural way of communication for Natural Human Computer(HCI) and recited that Real-time vision-based hand gesture recognition is considered to be more and more feasible for Human-Computer Interaction[9]. The touch monitor and leap motion are very applicable hardware for the purpose of usability. For the application of this system, a dual window display is constructed as shown in Figure 5.

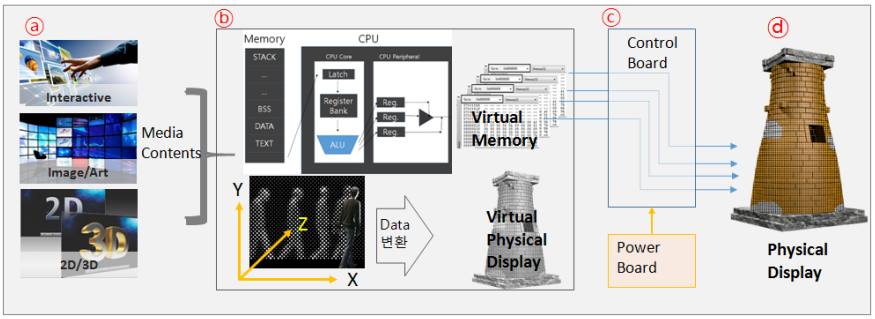

Figure 4: Design Diagram of Cheomseongdae/Data Conversion

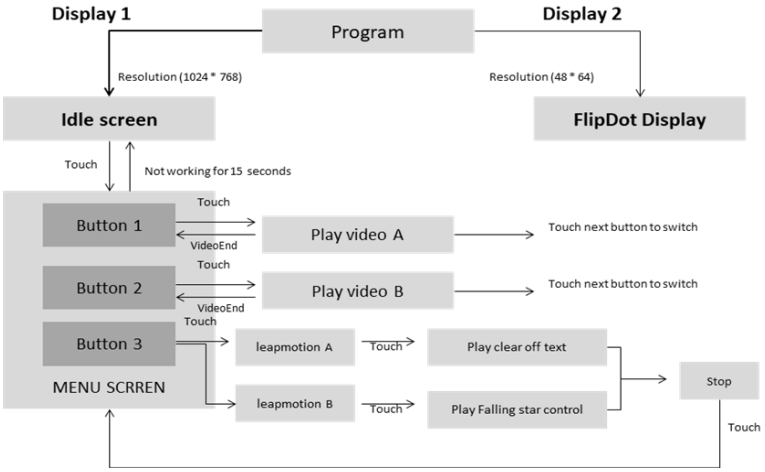

Figure 5: Dual Window Diagram

3.1. Touch Interface

We installed the hardware as an interface which recognizes the finger touch data as shown in Fig. 6. to enjoy various contents of the digital Cheomseongdae. The touch-based interface module is an interface for the user to synchronize the binarization flip image to the flip display of Cheomseongdae in the designated resolution and to output the finger position recognition information which is necessary for interface matching by storytelling. The monitor with built-in touch technology is installed in front of 1m at Cheomseongdae flip display.

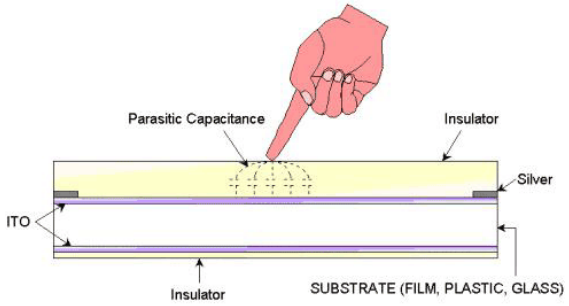

Figure 6: Touch Interface

3.2. Flip Display UI/UX Design

The touch UI should be used as an intuitive interface of flip display. The existing touch UI uses finger gesture recognition through simple x and y coordinate recognition such as single touch and multi touch as shown in Fig. 7. Therefore, the UI of Cheomseongdae monitor was planned to be designed for users to easily understand and experience it by combining the optimized and intuitive interface design.

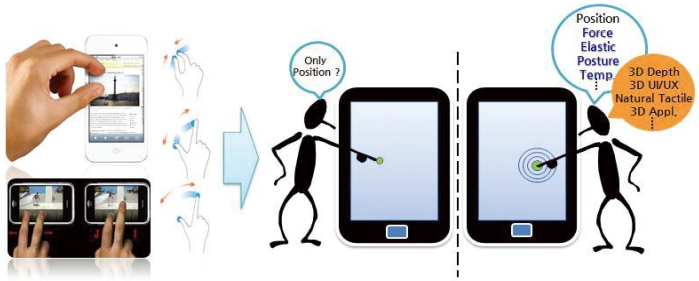

Figure 7: General Touch UI

The UI applied to Cheomseongdae was developed and produced in UNITY3D environment. When the user touches the idle screen as shown in Fig. 8, the binarized image selection buttons 1, 2 and Play LeapMotion buttons for Cheomseongdae are enabled. In addition, the user can touch and select the contents which are to be desired by himself/herself. The detailed development environment and configuration diagram are shown in Table 1.

Figure 8: Cheomseongdae UI

Table 1: Development Environment and UI Diagram

Development Environment	**UI Diagram**
OS: Windows 8.1 (64bit) Engine: Unity 5.4.0f3 Development Language: Unity C# Main Display: 10.4” Touch Display Sub Display: 24” LED Display (48 X 64 pixel) Driver: Leapmotion Orion 3.1.2	○ Idle screen (Looping) 1) Screen button ↓ ○ Operation screen 1) Button 1 2) Button 2 3) Button 3 (sub Button 1, sub Button 2, sub Button 3) ↓ ○ Idle screen (Looping) 1) Screen button

3.3. Binarization Image Processing

The interactive touch action transfers the real-time input image including created image to the flip main integration board in real time through binarization processing. In addition, it shows the contents through optimizing system with correction and post-processing functions. The content scenario of Video A or Video B is converted into black and white binarization image that can be applied to the Cheomseongdae flip display, and that video image is shown on the display. In UNITY3D, a real-time binarization system is provided with a port for external output and input, communicating in a local UDP mode, and transferring the image into the display in real time. The send and receive data for the input are shown in Figure 9[10].

```
/*
        ----------------------
        UDP-Receive (send to)
        ----------------------
        // [url]http://msdn.microsoft.com/de-de/library/bb979228.aspx#ID0E3BAC[/url]


        // > receive
        // 127.0.0.1 : 8051

        // send
        // nc -u 127.0.0.1 8051

    */
using UnityEngine;
using System.Collections;

using System;
using System.Text;
using System.Net;
using System.Net.Sockets;
using System.Threading;

public class UDPReceive : MonoBehaviour {

    // receiving Thread
    Thread receiveThread;

    // udpclient object
    UdpClient client;

    // public
    // public string IP = "127.0.0.1"; default local
    public int port; // define > init
```

```
/*
        ----------------------
        UDP-Receive (send to)
        ----------------------
        // [url]http://msdn.microsoft.com/de-de/library/bb979228.aspx#ID0E3BAC[/url]


        // > receive
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    UdpClient client;

    // public
    // public string IP = "127.0.0.1"; default local
    public int port; // define > init
```
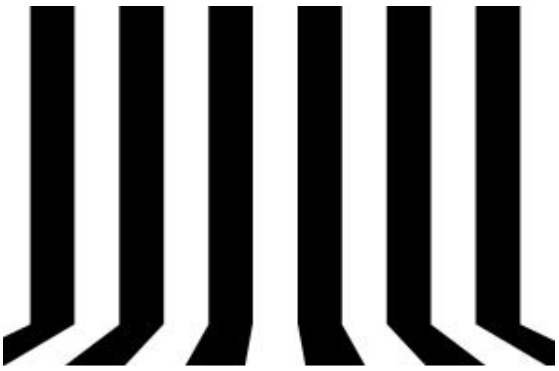
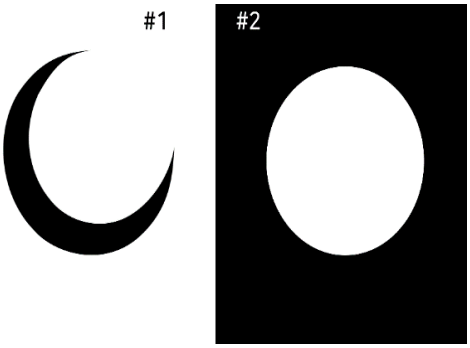
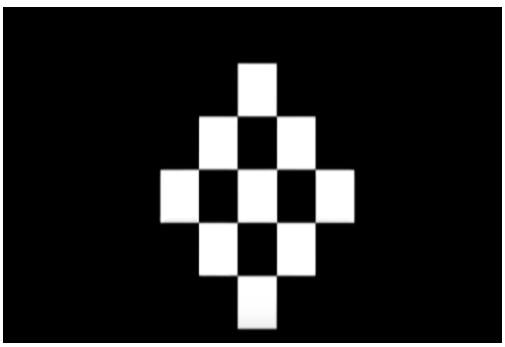

Figure 9: Send and Receive DATA in UNITY3D

3.4. Production of Binarization Image Contents

In case of binarization image that can show the history and meaning of Cheomseongdae, it can be selected from A or B, and scenarios and main scenes of each image content are same as Table 2.

Table 2: Image Content Scenario and Main Scene

Type A : "Into a bright future"	**Type B: "Cheomseongdae's pride"**
Synopsis: By utilizing the characteristics of flip-discs and the symbolic pattern-based animation in the binary method, the pattern of the contents centered on the dynamic performance of the history and meaning contained by Cheomseongdae has a story about the status of astronomical observations through Cheomseongdae, Cheomseongdae which have become treasures through long history, and the new hopes from them.	Synopsis: It is an infographic-oriented content that conveys the story of Cheomseongdae in a long history with a narrative form. It contains the history of Cheomseongdae with 1300 years, and the story of the wisdom of our ancestors who knew that Cheomseongdae was made of 365 bricks and helpful to understand the circulation of the four seasons, observing the Big Dipper and stars.
	
	
	

3.5. Leap Motion Recognition Processing

The Gesture type provided by Leap Motion allows the user to recognize actions that create or shake a circle, and the function Update () provided by unity's c # script to recognize a specific action is updated and applied in every frame. As shown in Fig. 10, users can enjoy the fun of interactive sculptures while naturally shaking hands with the position information of both hands of the user by applying leap motion in Unity3D environment.

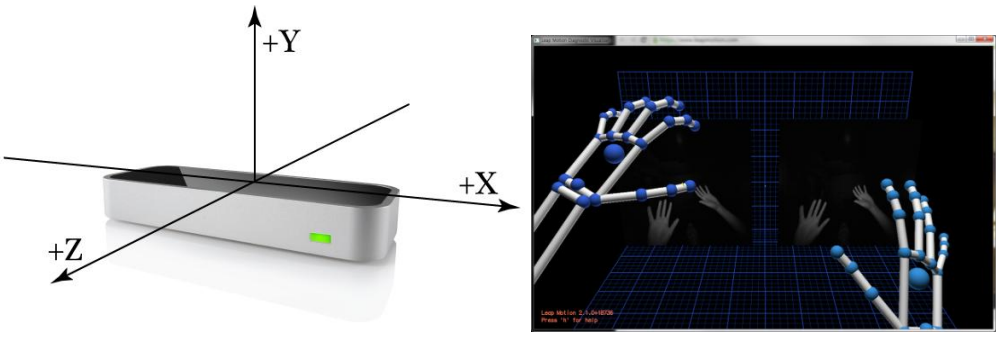


Figure 10: Leap Motion

When the user clicks the Play Cheomseongdae button on the touch monitor as shown in Figure 11, the user can choose two content experiences such as Clear off text and Get falling stars. As shown in Figure 12, the binarized text data is transferred to the flip display and the user freely waves his/her hands in front of the leap motion and plays a game with clearing off text in the desired direction. When clicking on the button to get the second falling stars, randomly binarized pieces on each disc will fall on flip display of Cheomseongdae like stars. After that user plays a game with getting falling stars using hands by quickly changing the position of the hands.

Figure 11: Leap Motion Interface

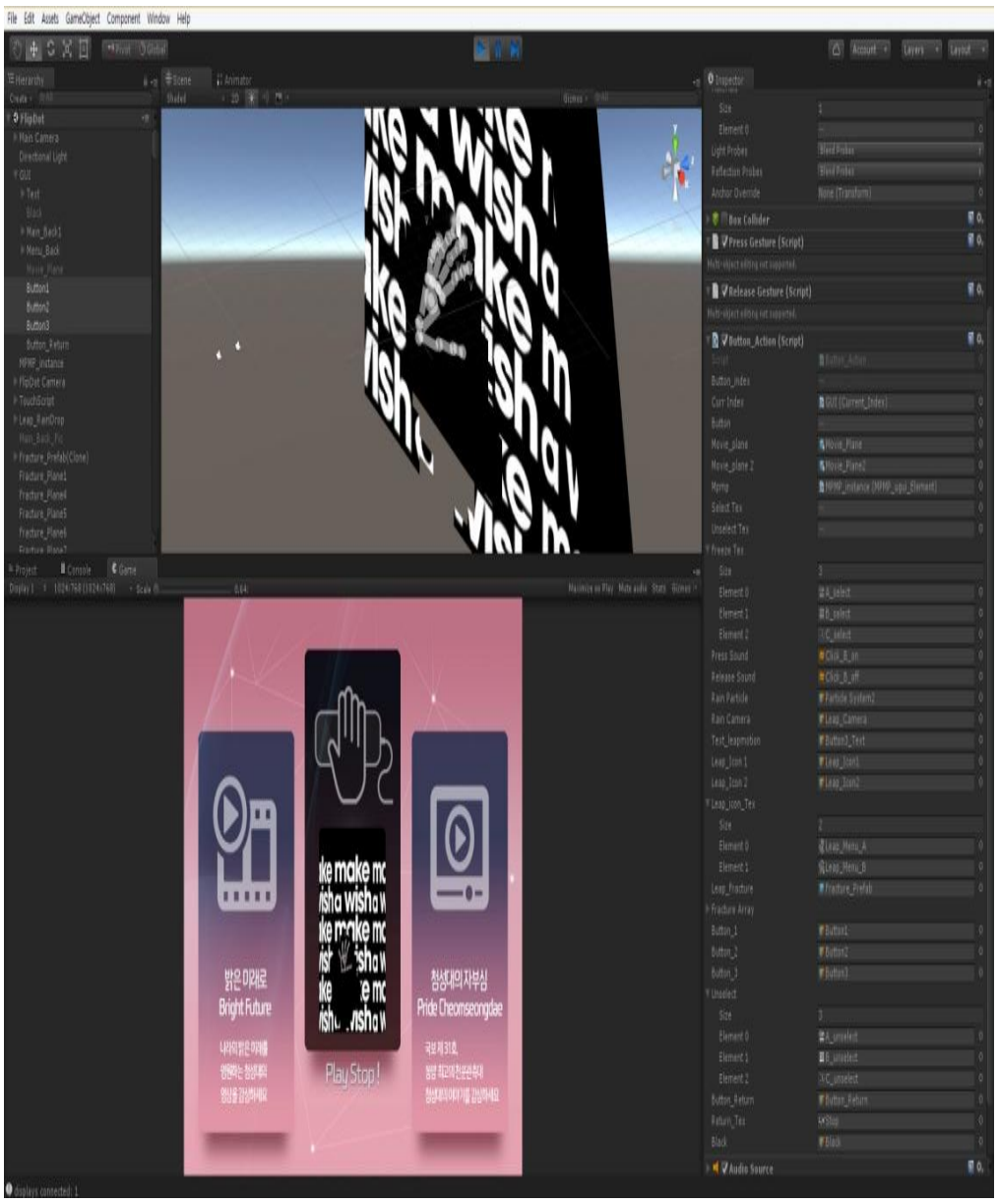


Figure 12: Leap Motion Effects in UNITY3D

3.6. Dual Window Interface

The content of Cheomseongdae is applied to the dual window interface and the selected data is transferred in two different display methods depending on the user's choice. One is to allow the operating screen to be displayed on the touch monitor, and the other is to be implemented by transferring to the Cheomseongdae flip display through binarization processing on the main board. The scripts for detailed commercial and development are shown in Table 3 and the entire diagram is shown in Figure 5 above.

Table 3: Script History

Commercial script (Plug-in, SDK) Editing history (C#)	**Own developed script (C#)**
○ Touch Script 1) Press, Release check ->linking with button ○ Movie Play Script (Plug-in) 1) Check the status of video play 2) Video A.mp4 and B.mp4 files link with each button -> Play different video depending on button 3) Check the video completion status ->change to idle screen in a certain period of time after completion ○ Leapmotion modules (Plug-in) 1) Check operation status 2) Apply collider ->Link to respond various particle 2) Check whether user'shand is recognized -> Change to idle screen ○ Sequence Image Player Script 1) Edit sequence image to be placed on the background screen as decoration and automatic looping ○ BlendMode Composite Script (Shader) 1) Decoration sequence Image on the background screen -> Screen composite to screen mode 2) Automatically and randomly adjusts Alpha value (blinking effect) ○ Fracture Script (Plug-in) 1) Set to respond to LeapMotion Colliderafter fracturing 1000 pieces of the character plane that will be deleted from "Leap Motion Operation 1"	○ Button Action Script (**Button_Action.cs, Main_Click.cs**) 1) On and Off setting of each button 2) Check time that button is not operating -> Go to idle screen after a certain period of time ○Target Display Script (Target_Display.cs) 1) Classification of main display and sub display -> Output to each display 2) Set the screen of sub display to 48 x 64 resolution ○ Particle Script (Prefab, Destroy_Particles.cs, Destroy_Fracture.cs) 1) Create particle 1 and 2 for leap motion operation 2) Createinstance each time user press Leap Motion 1 or 2 button ->Responding to LeapmotionCollider or automatically delete from the scene after a certain period of time (Destroy) ○Check current operating button or menu (Current_Index.cs) 1) Check whether the operating button and video are completed or not 2) If there is no operation, or there is no user's hand recognized by leap motion, move to the idle screen after a certain period of time (set to 15 seconds). ○ Mouse cursor On, Off / Scene exit (Cursor_Hide_Exit.cs) 1) Press the "C" key on the keyboard to show the mouse cursor, and press it again to disappearthe cursor. The initial value is not visible, but user can make the mouse visible when needed for emergency recovery. 2) Press the Escape button to exit the program. ○ Repeat by giving PingPong setting to alpha value of sequence image or icon (opacity_Looping.cs) 1) Give a variety of feelings by randomly repeatingthe alpha values on decoration sequence images used in the background.

4. Conclusion

It is highly likely to grow into a medium that can reveal the advantages of cultural business with a lot of actual contents, advertisement contents, and exhibitions/performances because the multivariate flip display development is a platform-based technology. In addition, in case of flip display with interactivity, it can be communicated through digital signage and extended experience between users since they participate and have experiences related contents including information delivery. This would be become the effective advertisement since user can experience information in a more active manner. In this study, we developed digital signage which shows binarization image content in a natural way by applying touch method as well as applying flip interactive display technology to Cheomseongdae sculpture as national treasure 31 of Korea. In particular, we developed software by applying leap motion device to Unity3D software for the purpose of inducing audience's direct participation and also developed an interface in terms of clearing off characters in response to a user's hand gesture or getting falling stars. This study has been

studied as a new media type of digital signage production case and it would be applicable to flip display by creating various contents which can be binarized in the future.

Acknowledge

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