A Study on Digital Signage Interaction Using Mobile Device

Jung Soo Lee, Sung Won Moon, Jeong Woo Lee, and Ki Song Yoon

***Abstract*—An interaction method between user and digital signage systems that are commonly used in digital signage is a touch screen method using the IR sensor. However the touch interaction device using the IR sensor has the advantage of high touch recognition rate, there are many shortcomings that it has high cost and influenced by the noise caused by illumination. In addition, it is hard to interact with user and contents that located in which does not reach the user's hand in case of the digital signage consisted of the large scale display devices. In this paper, it is intended to propose and implement a method for interaction with the digital signage display device using a mobile device that is often possessed and used in recent. As interacting with digital signage device using mobile device that installed interaction software, we can avoid the noise caused by light and interact with the large scaled display devices.**

***Index Terms*—Digital signage, interaction, IR sensor, mobile device.**

I. Introduction

Digital signage is a type of electronic device that shows information, advertisements, messages, TV programs, and so on. Such digital signage services are typically provided in a fixed location [1].

The environment for digital signage, however, has been gradually changing.

One of the many changes in advertisement is bi-directional service. The traditional advertisement system displayed the advertisement in one way to consumers. But the recent one is interactive with consumers through touch-screen, mobile phone, camera and etc. [2]-[4]. The interaction is the other big current of digital signage. It makes a digital signage far more useful. It can be included in user interaction techniques that buttons, touch-screens, multi-touch, gesture using camera and mobile phones [5]-[8]. Among them, the use of the touch-screen has experienced resurgence in popularity in the past five years as a result of the success of mobile devices that use this interactive interface, namely, the iPhone and Android smart-phones, as well as the increasingly popular tablet computers and e-book readers. An interesting consequence of this popularity is that people who see non-interactive digital signage are touching the screens and expecting a reaction. Even for digital signage that has a traditional touch capability users are likely to try using multi-touch gestures to zoom in and out on the display [9], [10].

IR (Infrared) sensors have been mainly used in digital signage field using touch-screen scheme. After surrounding the IR sensor around the display device, it is operated as sensing points that it is touched.

However touch interaction with digital signage system using IR sensors has the high touch recognition rate, there are many shortcomings that it has high cost and influenced by the noise caused by illumination. In addition, it is hard to interact with user and contents that located in which does not reach the user's hand in case of the digital signage consisted of the large scale display devices.

In this paper, it is proposed that the digital signage system interacting with users using mobile device. And also, we explain the method that operates multiple signage systems as if they were a single signage system and interacting with it.

The paper is structured as follows: Section II briefly describes the proposed overall system. Section III explains each module composing system. And it also provides various methods which can interact via the mobile device. It is showed that the system is how to operate through the implementation in Section IV. Section V concludes the paper with a summary of key points.

II. The Concept of the System

Fig. 1 shows a conceptual diagram of the proposed system. The display devices are connected to display system 1 and 2, respectively and the digital signage display system for digital signage is operated. However, the content management included into system 1 and 2 is operated as if they were a single system. In general, IR sensors are installed in the periphery of the display device 1 and 2 for interaction with users, which makes device cost increased significantly for display device being manufactured in a large size. In addition, since the IR sensor driver is applied independently to the system, user interaction is processed independently also.

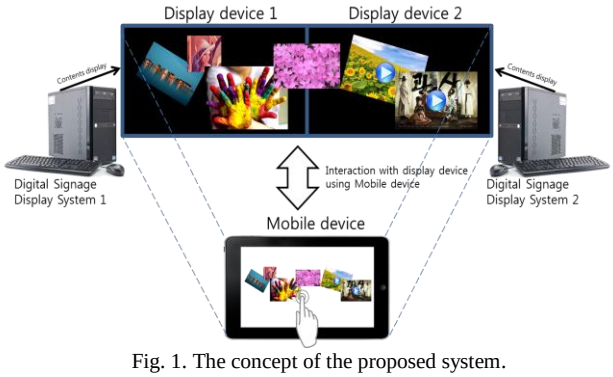

Fig. 1. The concept of the proposed system.

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However, the two systems can be operated as a single system as processing the signal input through the mobile device if interacted with content included in each system using mobile device as proposed in this paper.

III. Interaction and Content Synchronization

A. Intuitive Interaction Method

The application that contains information about the display device must be installed on your mobile device to interact mobile device with digital signage display system consisted of a large display devices. It should be contained that the size and resolution information of the display devices.

This section should provide convince the examiners that you answered the question or solved the problem. So show what you did that is relevant to answering the question or solving the problem. Authors can change the section title.

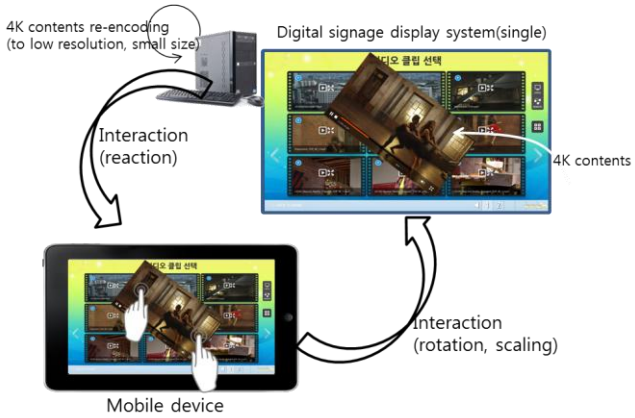

Fig. 2. Interaction with mobile devices and a single digital signage display system.

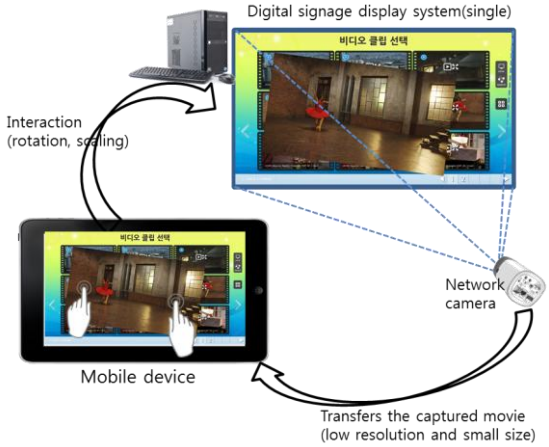

Fig. 3. Interaction with digital signage display system using web-cam and mobile device.

If the size and resolution of the display device of the digital signage display system are recognized via a mobile app, it can be displayed on a mobile device reducing the contents that is displayed on the display system. In general, since the resource of the mobile device is less than the desktop system and network bandwidth is also limited, it is difficult to transfer and display contents in original size on mobile device. Therefore the content existed in the desktop PC should be re-encoded by scaling them down and decreasing the resolution of them.

It is possible to configure the system without the hassle of re-encoding using a webcam as shown below.

As shown in Fig. 3, the re-encoding process of Fig. 2 can be easily replaced taking contents displayed on the display device using web camera and transferring to mobile device.

B. Sequential Interaction Method

Because the intuitive interaction method described above must match the big screen with a small mobile device screen it has the disadvantage that contents are displayed in small on the mobile device. Fig. 4 illustrates the sequential interaction method.

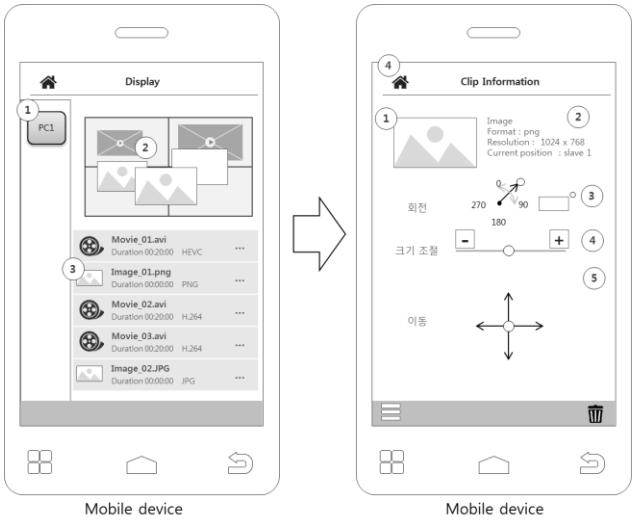

Fig. 4. The sequential interaction method.

It is way to interact with the selected content after selecting the content of the desktop PC. That is, because the only selected content that is one of contents on the desktop PC is shown in mobile device, the interaction with user and the content can be done more precisely.

C. Interaction of Multiple Digital Signage Display Systems

It is way to interact mobile device with multiple digital signage system, which can be operated in a same manner interacting single digital signage system with mobile device. But it is necessary to set a virtual display space with the total resolution of multiple systems for more natural interaction between multiple digital signage display system and mobile device. In addition, it is necessary to make content synchronization between multiple systems for the content to be played over between them in order to make the multiple systems seem like a single system.

D. Content Synchronization

It is an eyesore thing if content synchronization is dislocated due to a network delay or the difference of the specification between systems when contents are played in multiple digital signage display systems like as a single system. Therefore it is necessary to synchronize the content between digital signage display systems.

In this paper, a content synchronization is designed by applying PTP (Precision Time Protocol) which has been used to synchronize the time between systems. Fig. 5 describes the design of the content synchronization by matching the frame of the content currently being played instead of time used in

PTP scheme [11]-[13].

Firstly master system to transmit the reference frame of the content currently being played and slave system to match the playback frame with a master system are required. If the frame of the content that is being played at the master system is referred to as MF (Master Frame) and the frame of the content that is being played at the slave system is called to SF (Slave Frame), the content frame of the slave system is synchronized to the master system is shown below expression.

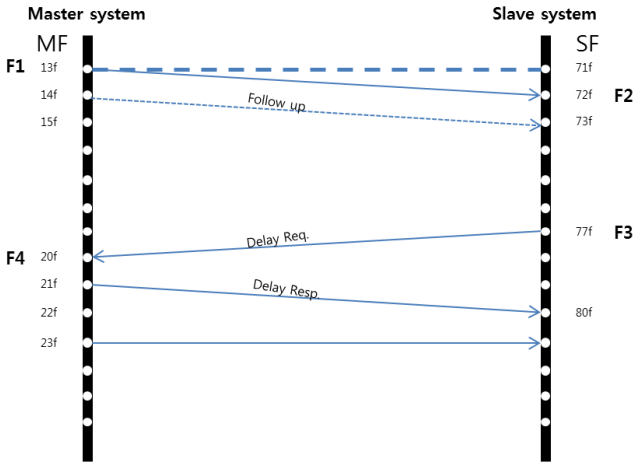

Fig. 5. The content synchronization using PTP scheme.

$$\text{CSF(Corrected Slave Frame)} = \text{SF} - \text{Offset from Master} \quad (1)$$

where,

$$\text{Offset from Master} = F2\text{-}F1\text{-}MPD \quad (2)$$

where *MPD* refers to mean path delay.

$$\text{MPD} = [(F2\text{-}F1)+(F4\text{-}F3)]/2 \quad (3)$$

If the content playback frame is set in the master system and the slave system as shown in Fig. 5, *MPD* is 1 and Offset from Master is 58. Therefore CSF is 23 and applying this value to slave system the playback frame of the content of both systems is exactly synchronized.

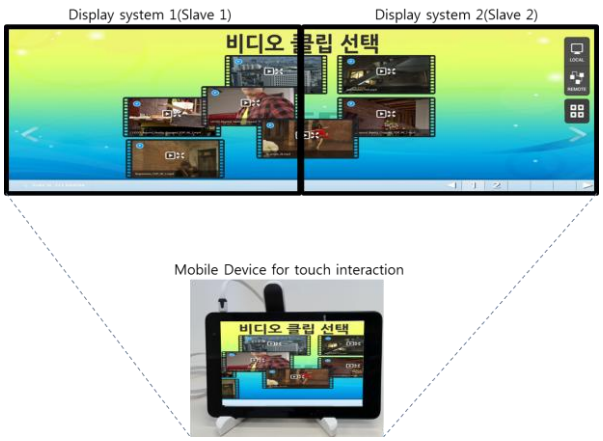

Fig. 6. The configuration of interaction system using mobile device.

IV. Simulation

In this paper, the interaction using mobile device was applied to two digital signage display system. Both systems are capable of displaying 4K (3840×2160) content and the full resolution of both system is 7680×2160. Interaction method of the mobile device was used for intuitive interaction method.

The content synchronization between both digital signage display systems was driven by making program separately and it was possible to adjust exactly the playback frame of the content between both systems using the periodic synchronization signal of the master system even though there were two frames difference between both systems.

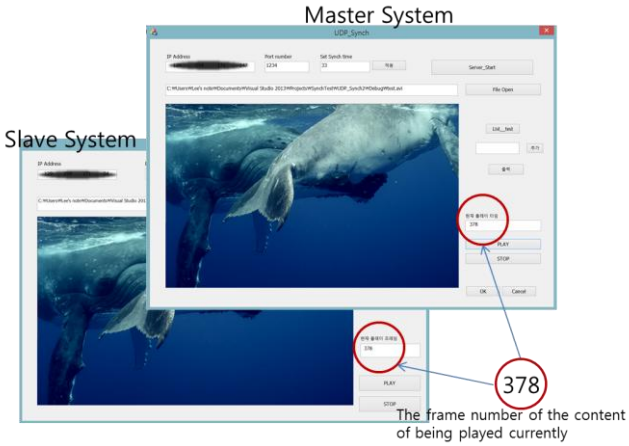

Fig. 7. Contents synchronization between two systems.

V. Conclusions

In this paper, we proposed a method and system configuration that could interact with the digital signage display system using the mobile device. When using the proposed method in place of the touch interaction using the IR sensor that was used previously, which may drop the cost of the device for interaction significantly and also will eliminate the inconveniences that cannot interact due to the physical condition of users. In addition, because there is no interference with the light in mobile device unlike IR sensor the proposed interaction system will be used as an efficient interaction tool between the digital signage display system and user

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