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Implementation of Video Mirroring System based on IP

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Abstract

The recent development of information and communication technology has a great impact on the audio/video industry. In particular, IP-based AoIP transmission technology and AVB technology are making changes in the audio/video market. Video signal transmission technology has been introduced to the market through a network, but it has not replaced the video switcher function. Video signals in the conference room or classroom are still controlled by the switching device. In order to switch input/output video devices, a cable that is not limited by distance must be connected to the switcher. In addition, the control of the switching device must be performed by a person who has received professional training. In this paper, it is a technology that can be operated even by non-experts by replacing complex video cables (RGB, DVI, HDMI, DP) with LAN cables and enabling IP-based video switching and transmission (Video Mirroring over IP: VMoIP) to replace video switcher equipment. We are going to do this study, I/O videos were controlled in the form of matrix and high-definition videos were transmitted without distortion, and VMoIP is expected to become the standard for video switching systems in the future.

Key words: *Video mirroring, Video Transmission, Switcher*

1. Introduction

In order to transmit computer videos to a projector and a specific screen in a meeting or lecture space using multiple computers, various A/V cables from a computer to a video switcher must be installed [1]. In addition, the operation of equipment according to the progress of meetings or lectures should be controlled according to changes in the situation. This paper is a study to mirroring PC video through IP-based switching technology. Video mirroring over IP (VMoIP) excludes the physical environment (switcher, video cable, audio cable) and enables convenient operation and management through an IP-based system. Chapter 2 analyzed the video switching technology, and Chapter 3 analyzed the VMoIP system configuration. Chapter 4 describes the VMoIP implementation technology, and Chapter 5 discusses the conclusion and future tasks.

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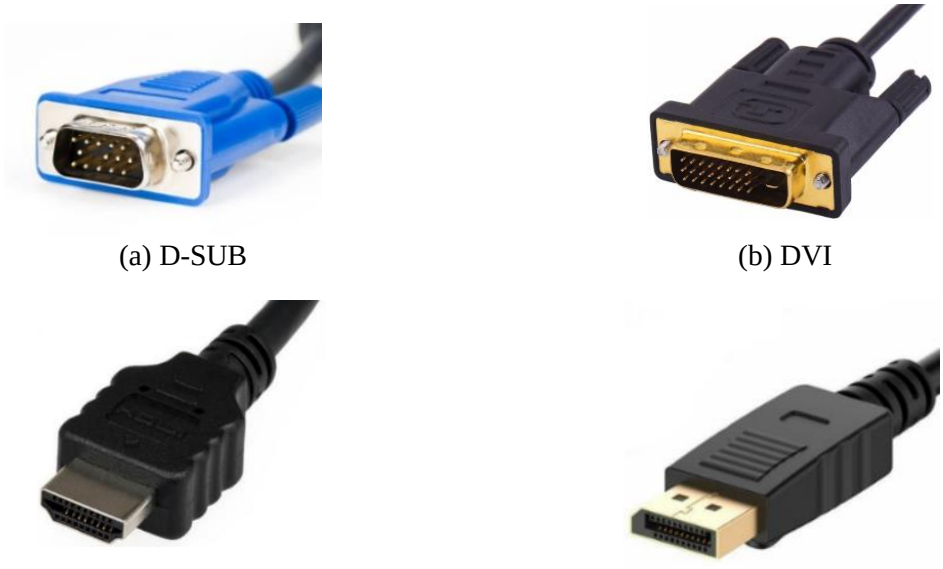
2. VIDEO SWITCHING TECHNOLOGY

In order to output videos to output devices such as projectors and monitors in conference rooms or lecture rooms, equipment such as video switchers and video distributors must be used [2, 3].

2. 1 COMPUTER DISPLAY CONNECTOR

Computer video displays input/output data information in the same way as television, and outputs it in a raster method. The raster method is outputting pixels densely listed in the form of a horizontal and vertical grid. Computer video signal output is transmitted to the outside by connecting a cable to the output terminal [4]. D-Subminiature (D-SUB) was developed by IBM in 1987 and is still called D-SUB, RGB, and video graphic array (VGA) in ways used for graphics cards and monitors [5]. Digital visual interface (DVI) is a technology developed by Intel companies that compresses and transmits digitized video information data to eliminate noise generated in analog videos. There are eight official international transmission specifications via DVI, but three (DVI-I, DVI-D, and DVI-A) signal specifications are used a lot [6]. High-definition multimedia interface (HDMI) is a proprietary audio/video interface for transmitting uncompressed video data and compressed or uncompressed digital audio data from an HDMI-compliant source device. Display port (DP) is a display interface standard developed by Video electronics standards association (VESA). DP is a technology developed to relieve the burden of paying technology fees because it does not pay patent royalties for using HDMI technology [7]. In addition, it is compatible with D-SUB, DVI and HDMI ports by using the conversion gender. Recently, as the penetration rate of monitors supporting DP technology increases, the demand for DP transmitters is also increasing. Figure 1 shows an external view of the video cable connector. As an interface for conventional video equipment, HDMI is used as a standard interface for various devices such as PC, set-top box, blue-ray player, and HDTV [8]. HDMI is a technology that transmits audio and video signals separately through a single cable, and supports UHD video and up to 7.1 CH. It is compatible with D-SUB, DVI, and DP ports by using the conversion gender.



(a) D-SUB (b) DVI

(c) HDMI (d) DP

Figure 1. Display cable connector outside view

2. 2 SWITCHER

Video distributor and video switcher are used to select and transmit video signals to multiple or specific monitors. Switcher input/output ranges from 1:2 to 64:64, and there are many products on the market with different functions and characteristics for each manufacturer. For video transmission, the video signal of the input section should be installed to the switcher using a cable (D-SUB, DVI, HDMI, DP), and should be transmitted using a cable from the switcher to the place where the video equipment of the output section is installed. The switcher can be controlled manually or by using serial communication depending on the characteristics of the product [9, 10]. Figure 2 shows the configuration diagram of switcher. There are various types of video switcher according to the output of video equipment and input/output characteristics such as RGB, DVI, HDMI switcher. The video distributor distributes video signals to multiple signals so that they can be output. The video switcher is capable of outputting an input signal in a matrix structure. Input #1 in Figure 2 can be output as Output #1 or the entire Output Section. If Input #1 outputs the entire Output Section, Input Section devices except for Input #1 cannot output. In addition, when configuring the system using a video switcher or distributor, long-distance transmission is not possible due to the characteristics of equipment and cables.

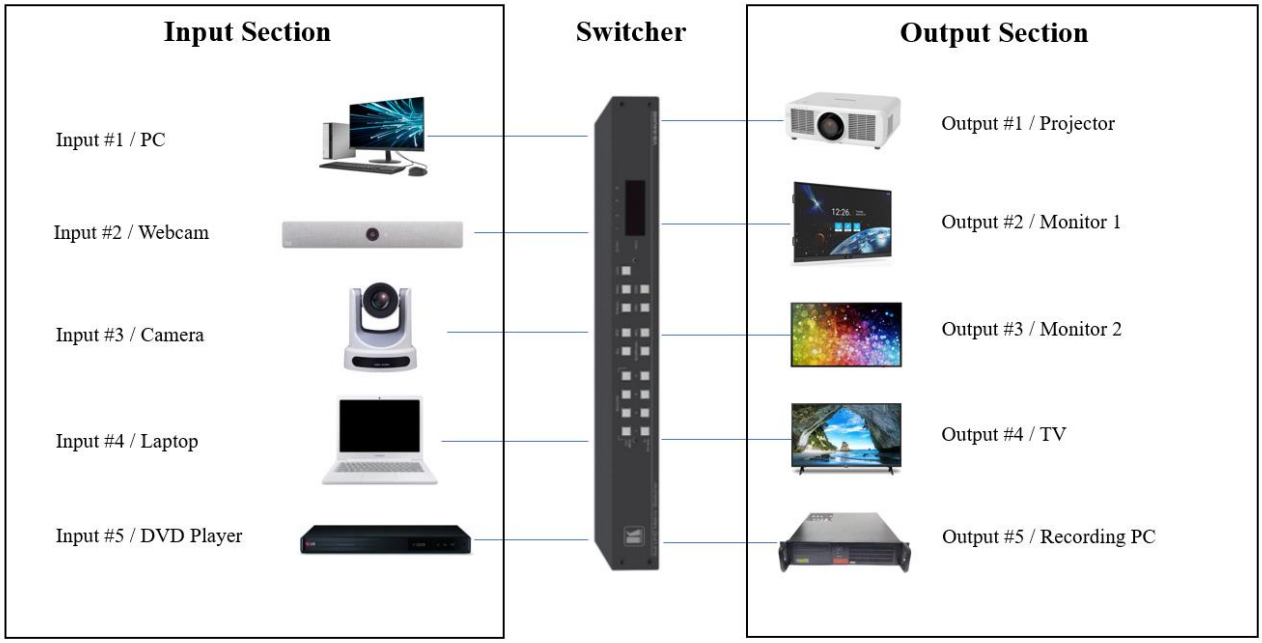


Figure 2. Switcher diagram

2. 3 VIA SYSTEM

VIA System is a system developed by Kramer electronics, and it is a system for a large number of participants (up to 255) to connect to one display device (TV, projector, etc.) through wireless Wi-Fi or wired connection [11]. Figure 3 shows the VIA system configuration diagram. VIA is a wireless collaboration and presentation solution that enables wired and wireless communication of personal computing systems (desktop PCs, laptop, tablet, smart devices) to be output to display devices, which can be shared and presented more

easily at meetings. However, it is not possible to control input/output in the form of a matrix like HDMI switcher.

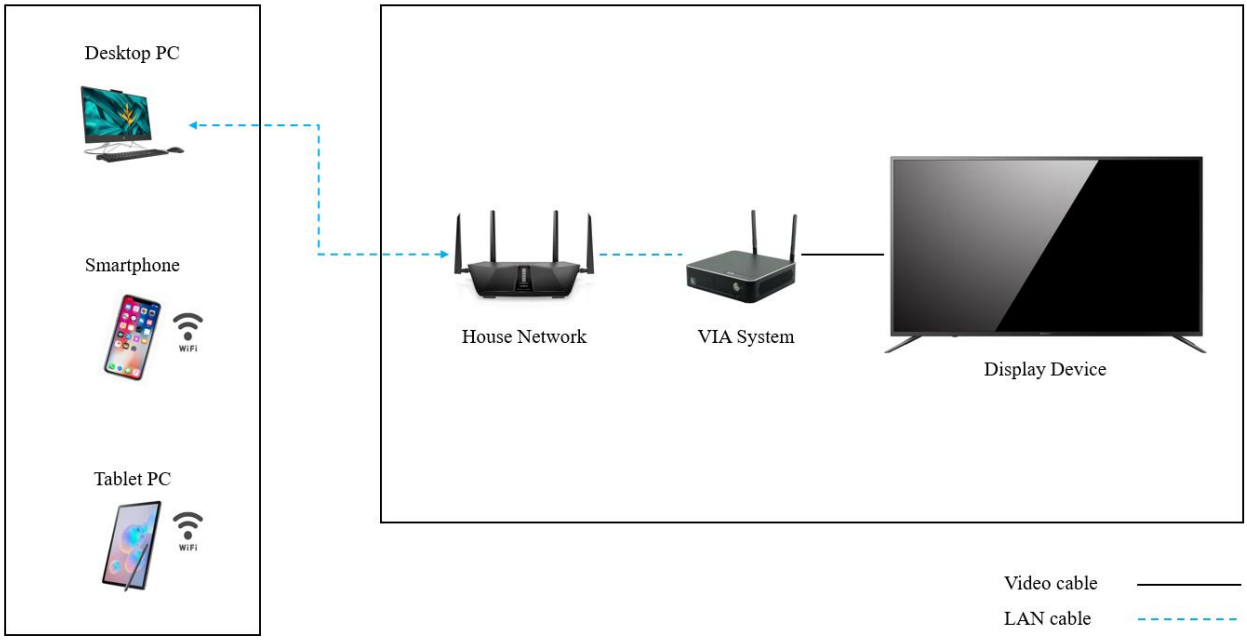


Figure 3. VIA system diagram

3. VMoIP SYSTEM CONFIGURATION

VMoIP is a system that can output multiple computer videos (up to 255) in matrix form (up to 255) and is a study to be implemented based on IP. The application of the VMoIP system was applied to the video system of the Reuters trading center (hereinafter: Reuters) of the seoul campus of Korea advanced institute of science and technology (KAIST). Reuters is a place where lectures are given by projecting different videos on each screen with 37 computers (36 Users, 1 Lecture) and 3 LCD Projectors based on zero clients. Zero clients are not using the graphics card used by the desktop, Therefore, in order to transmit each user's computer video to the outside, it is an environment in which it cannot be transmitted using the existing method (switcher or VIA system). In particular, Reuters should be able to project 37 computer videos onto 3 projectors as different videos or the same videos. Figure 4 shows the configuration diagram of the VMoIP system. VMoIP can be operated by setting all or groups of users (37 User: 1 Lecture, 36 User / 3 Group: 3 Projector) depending on the environment of use. When using a video switcher to transmit video to a specific screen, the switcher must be controlled. In addition, when using VIA, the transmitting user must stop the transmission before transmitting another user's video. VMoIP can transmit the video of the designated screen by clicking a button on the user's computer screen to use. Lecture computer and user computer can transmit the screen of each monitor based on IP. Video transmission can be output by designating or grouping the output through the control computer. In case of outputting video from the user computer, it can be used after registering the IP in the control computer and installing the VMoIP transmission program.

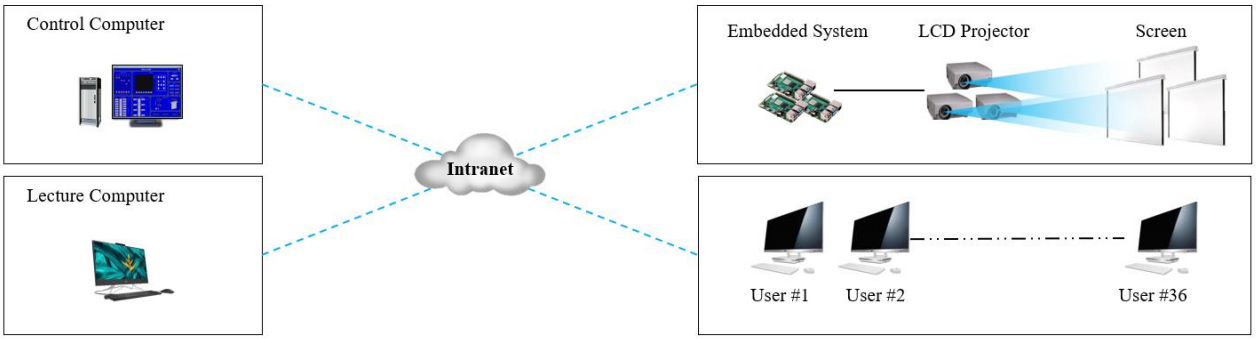


Figure 4. VMoIP system diagram

Table 1 compares computer video switching. VMoIP is currently available only in Windows environments, but because it transmits and receives videos using LAN cables, it can transmit videos without restrictions on distance and function as a matrix. By making it available for Mac and Android in the future, it will be a system that can solve the inconvenience of cable work and operation by replacing the function of video switcher.

Table 1. Computer display switching system comparison

Feature	HDMI Switcher	VIA System	VMoIP	Remark
Input/Output	64 : 64	255 : 1	255 : 255	
Control	Operator	User consultation	User	
Wire	HDMI Cable	LAN, HDMI Cable	LAN Cable	
Distance	X	X	O	
Matrix	O	X	O	
OS		Windows, Android, Mac	Windows 10	

4. IMPLEMENTATION OF VMOIP

Transmission of user computer display is to transmit screen based on IP in intranet environment. Each user computer has an IP, and up to 255 user computers are configured to transmit displays between users. Figure 5 shows a system configuration diagram for the User Computer to show its screen to other users. The operation of VMoIP was made possible through the program for transmitting the display to the user computer (VMoIP Play) and the control program of the control computer. User computer display transmission is started by clicking the VMoIP Play button. The control computer checks whether each user computer clicks the VMoIP Play button in real time. By clicking on the user computer, IP and Connect information are transmitted to another user computer. The user computer that has received the IP and Connect information receives the clicked user computer's video data through real time message protocol (RTMP).

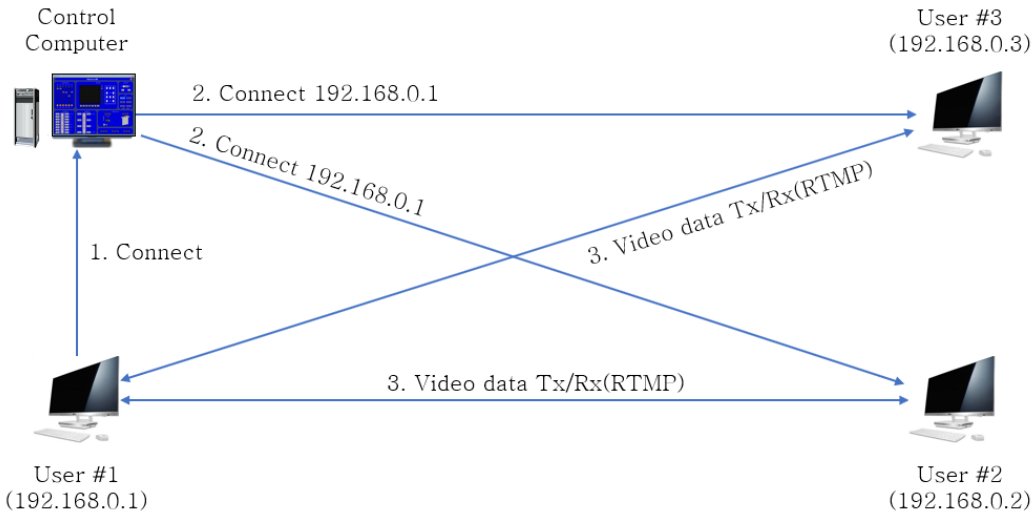


Figure 5. Computer display broadcasting system diagram

Figure 6 shows the configuration diagram of VMoIP system switching. It is a picture for transmitting the screen of User #2 Computer (IP: 192.168.0.2) when the screen of User #1 Computer (IP: 192.168.0.1) is being transmitted. User # 2 Computer screen transfer starts after stopping User # 1 Computer screen transfer by clicking the VMoIP Play button. User # 2 Computer clicks the VMoIP Play button and sends connect protocol to the control computer to notify the use, and sends a transmission stop command (an_connect) to User # 1 Computer in use. User #1 Computer stops the screen transmission program and sends the result (an_disconnect) to the Control computer. The control computer sends a video data RTMP stop command (Disconnect) to the other user computer that was being received from User #1 Computer. Then, it sends the IP and connect information of User #2 Computer. Upon receiving the IP and connect information of User #2 Computer, the computer receives a video from the IP (192.168.0.2) through the video data RTMP.

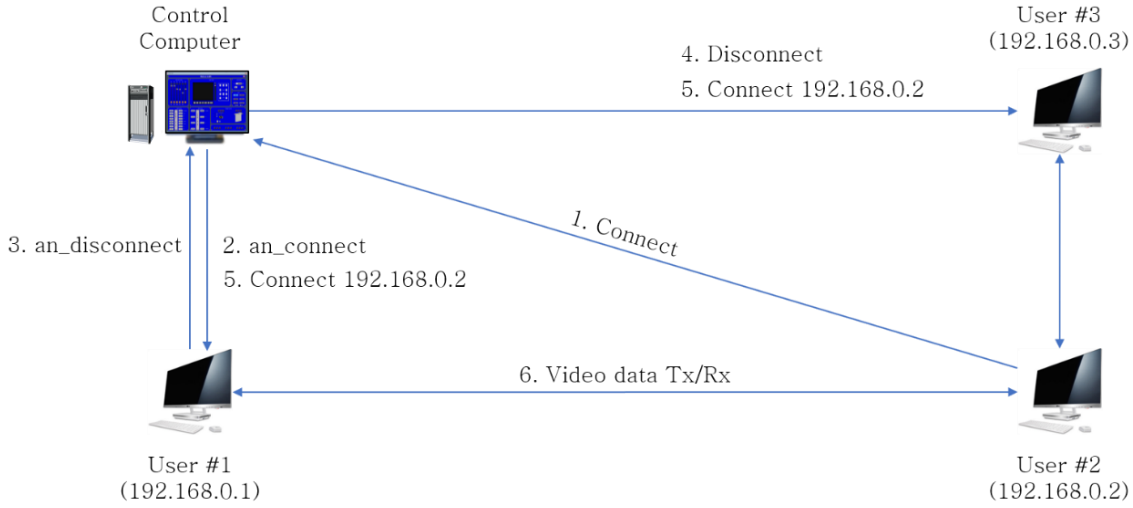


Figure 6. VMoIP system switching diagram

Figure 7 and Figure 8 are a diagram showing the program processing of the control computer and the user computer. Figure 7 shows the processing of the control computer program. The IP information of each user computer enables the addition or deletion of related information to the database server. When the program starts and broadcasts by fetching the registered user computer information from the database server, the information of the sending computer is delivered to the receiving computer. The receiving computer receives the display information of the transmitting computer with the broadcasting information of the transmitting computer. Network setting creates a socket and transmits data related to the connection protocol reception processing of the user computer to be broadcast to each user computer. Event process handles the data input by ComboBox Event and Broadcasting receiving Event respectively. Data input through the network processes data received through UDP threading. ComboBox Event enables processing of video signals as Matrix and Group through GUI environment.

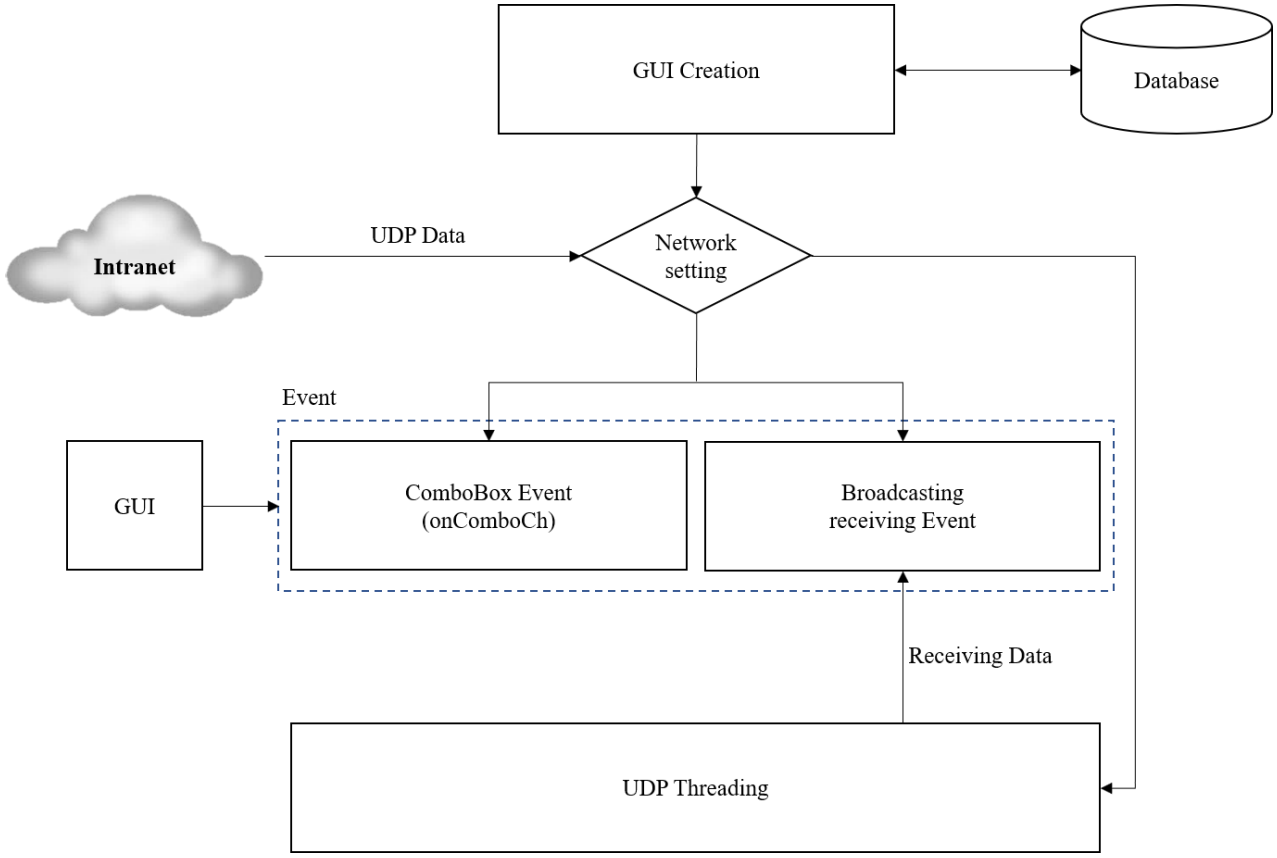


Figure 7. Control computer data process

Figure 8 shows the user computer program processing. When the Start button is clicked, the Connect protocol is transmitted to the control computer. Display capture sends computer screen capture information to the Broadcasting server. Display capture transmits videos through resolution and frame per second (FPS) settings. In case of reception by the user computer, after checking the information of the computer to be broadcasted in the UDP data process, the Capture player is operated. The received Broadcasting data is executed by Capture player through RTMP.

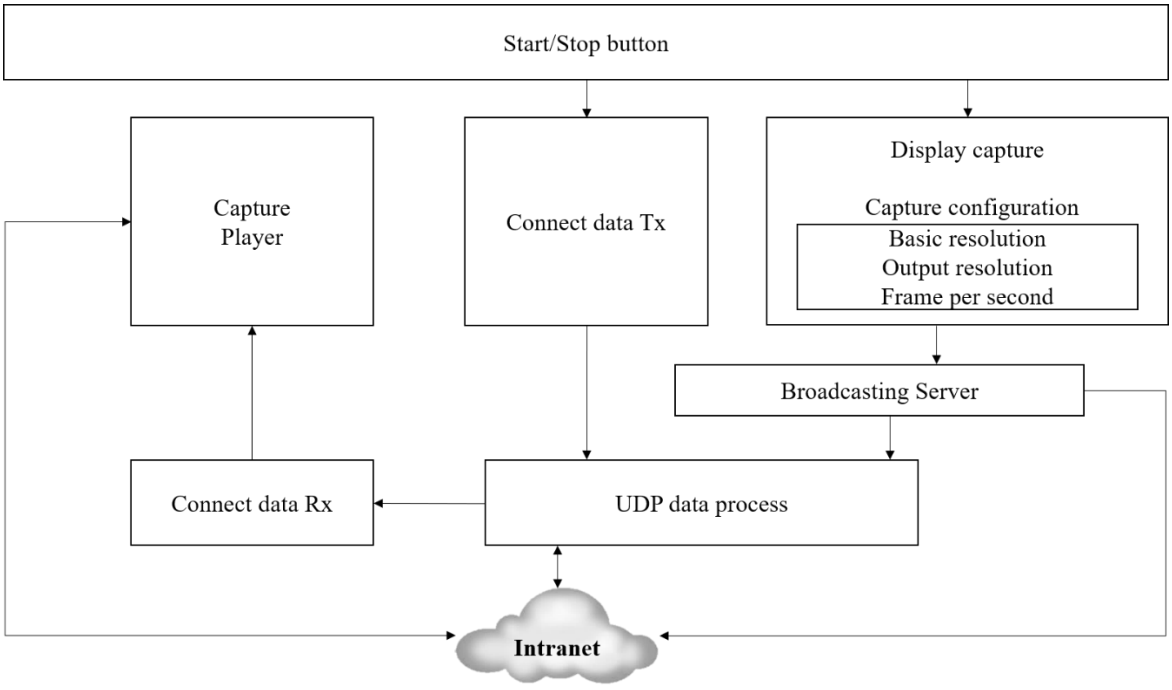


Figure 8. User computer data process

Figure 9 shows a diagram showing the GUI environment for implementing VMoIP in a computer. The video signal control can be controlled by each PC user and operator (A/V system manager). For switching and distribution of video output, the IP registered in the database server can be grouped to output in the form of a matrix structure. IP registration and deletion are possible on the Database server, and for system security, only system administrators and authorized personnel can be configured.

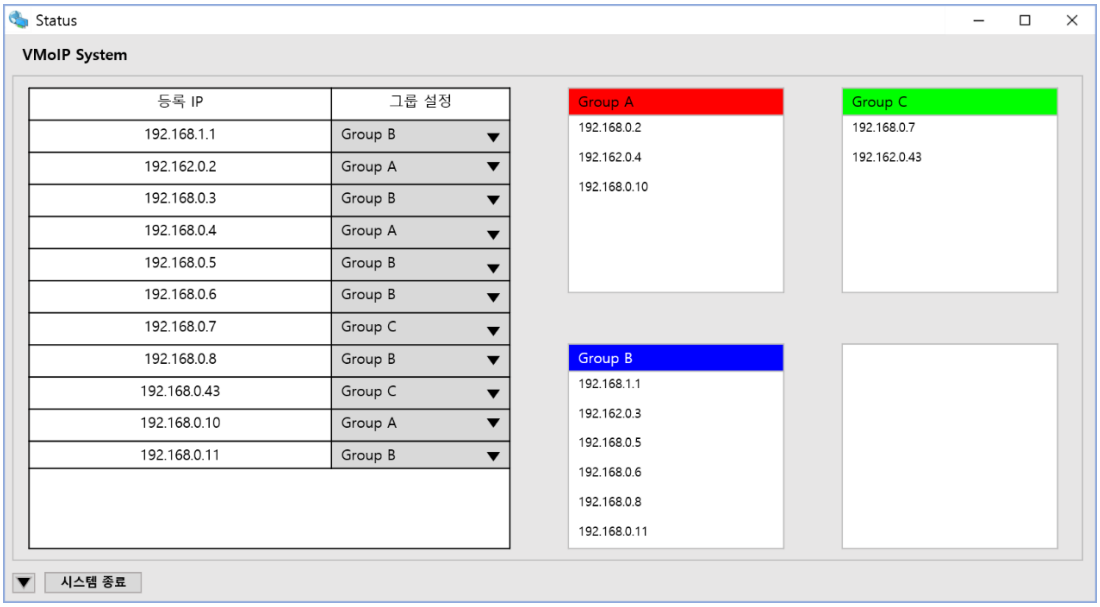


Figure 9. Control computer GUI configuration

5. CONCLUSION

In this paper, we proceeded as follows to switch computer video signals based on IP. First, the wiring of equipment by video cables was avoided and computer video signals could be transmitted and received based on LAN cables. By using a LAN cable, video transmission can be transmitted over a long distance, making it possible to supplement the limitation on distance, which is a problem of the existing video cable. Second, it enables convenient operation by allowing computer users to output computer video signals. Third, the IPv4 address system was used to enable the operation of the system in the form of a matrix up to 255 input/output signals. Through the results of this study, it will be possible to reduce the economic loss due to the facility and management of the computer video switching system. In addition, the IPv6 address system may be used to switch the video signal without limitation of the number. In the future, we look forward to becoming a new paradigm for video switcher system technology through VMoIP technology.

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