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A study on the audio/video integrated control system based on network

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Abstract

The recent development of information and communication technology is also affecting audio/video systems used in industry. The audio/video device configuration system changes from analog to digital, and the network-based audio/video system control has the advantage of reducing costs in accordance with system operation. However, audio/video systems released on the market have limitations in that they can only control their own products or can only be performed on specific platforms (Windows, Mac, Linux). This paper is a study on a device (Network Audio Video Integrated Control: NAVICS) that can integrate and control multiple audio / video devices with different functions, and can control digitalized audio / video devices through network and serial communication. As a result of the study, it was confirmed that individual control and integrated control were possible through the protocol provided by each audio/video device by NAVICS, and that even non-experts could easily control the audio/video system. In the future, it is expected that network-based audio/video integrated control technology will become the technical standard for complex audio/video system control.

Key words: *Audio mixer, Anchor, OAC, Video switcher, VMoIP*

1. Introduction

The audio/video system was mainly used for large-scale performances, lectures, and cultural events, but through network technology, it has recently been used in small-scale gatherings such as multimedia environments and conference rooms as well as industrial sites. Network-based audio/video systems are emerging as a new form of system configuration based on advanced information and communication technology infrastructure, and have become essential elements in industrial sites and multimedia environments [1, 2]. Since audio/video devices use a combination of multiple devices with different functions, only those who have received professional training in audio/video systems can control it, and it is difficult for non-experts to control it [3]. In addition, audio/video products released on the market are only being released for experts to control, but products for non-experts are not being released. This paper is a study to implement a device that allows non-experts to control the audio/video system without restrictions in time and space, so that products

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from different audio/video manufacturers can be integrated and controlled. In particular, Audio network & control hierarchy over peer to peer (Anhcor) technology and Video mirroring system based on IP (VMoIP) technology, which are emerging as new technologies in the audio/video market, are integrated so that they can be controlled through Network-based audio/video integrated control system (NAVICS), an embedded device implemented in this paper. The GUI of the audio/video system is capable of receiving and processing smart phone, touch panel, and PC data. In the paper, NAVICS analyzed the operation status of serial data transmission and reception of 8 channels and TCP and UDP data transmission and reception through the Ethernet port, and integrated control of audio / video device was implemented through stable data processing.

2. Audio/Video control technology

The audio/video system is operated by combining devices with different functions. The control of the conventional audio/video system could be controlled by an audio mixer and a video switcher by an audio/video expert. However, with the advent of the Anchor system and VMoIP technology, the composition of the audio/video system has been simplified and the control of the system has been simplified.

2. 1 Anchor system control technology

Anchor system is a new technology that transmits and receives audio signals through the network, replacing not only audio transmission but also audio mixer, and configuring the audio system using On-Site Audio Center (OAC). Figure 1 shows the Anchor-based audio system configuration diagram. The audio system of the Anchor technology transmits and receive the audio signal through the OAC. The transmission OAC of Anchor technology can use Stereo 16 channels, and the output can be used unlimitedly. The receiving OAC can select 16 channels of the transmitting OAC to mixing and control. OAC is equipped with conventional audio mixer, graphic equalizer, and time delay functions, and it helps to reduce facility cost for audio device by simplifying complex audio systems [4, 5]. Since the control environment of the Anchor system is controlled through the Windows-based GUI, it is vulnerable to Microsoft's regular updates and security.

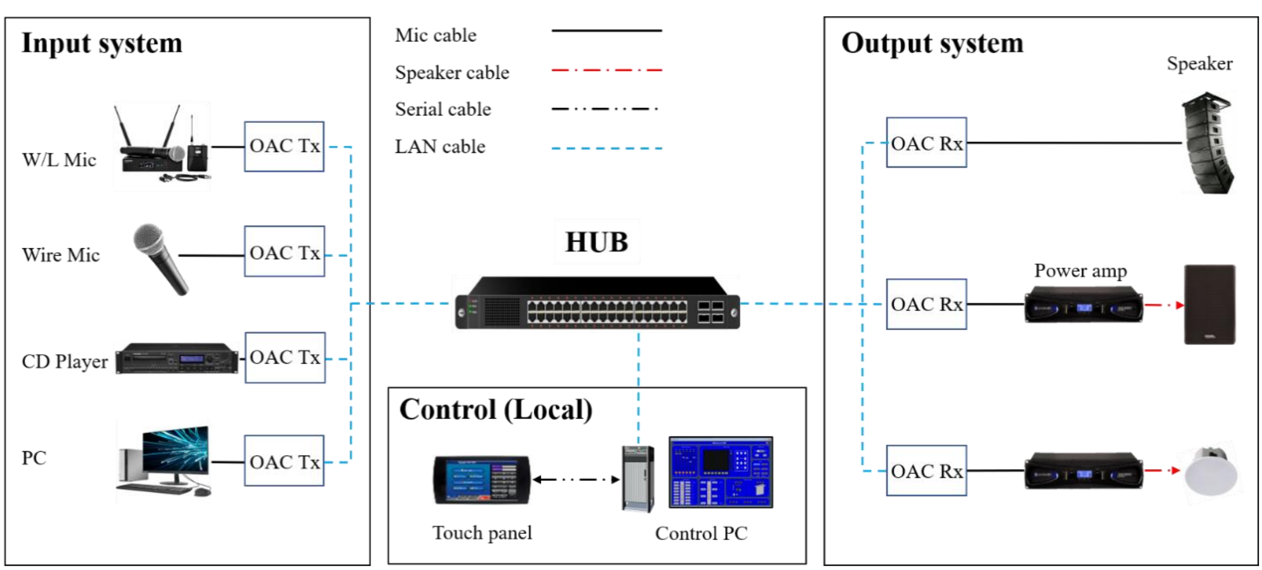


Figure 1. Anchor based audio system configuration diagram

2. 2 VMoIP control technology

VMoIP technology is a system that can switch multiple video signals based on IP. In a general video system, cables should be laid up to the switcher according to the video device terminals (VGA, DVI, HDMI, DP) of the input part, and the cable should be used to transmit from the video control device to the place where the video device of the output part is installed [6, 7]. In this way, the complex video system configuration can be mirrored by replacing each video cable with a LAN cable through VMoIP technology. Figure 2 shows the VMoIP-based video system configuration diagram. Video switching based on VMoIP can output up to 255 video signals in the form of a matrix of 255 video signals. The video signal can change the cable according to the input-output terminal (VGA, DVI, HDMI, DP) of each video device through the VMoIP Embedded system to LAN. Transmission of the video signal uses a LAN cable to transmit and receive the video. Video signal control can be output and grouped through touch panel or control computer [8]. VMoIP-based video system excludes the physical environment (video switcher, video cable and audio cable) and enables convenient operation and management through the IP-based system. However, video signal control is controlled through a Windows-based GUI like the Anchor system, so there is a disadvantage in that it is vulnerable to Microsoft's regular updates and security.

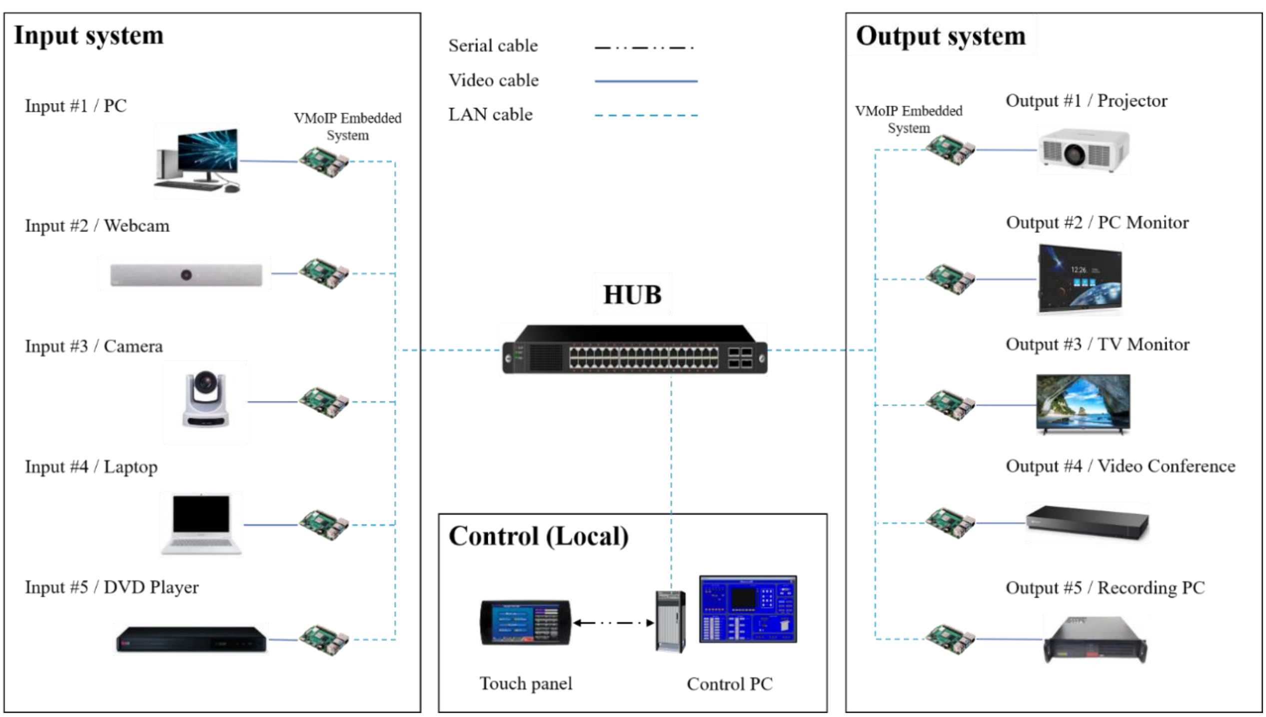


Figure 2. VMoIP based video system configuration diagram

2. 3 Communication control technology

The microprocessor can exchange information with the outside through a peripheral device. In general, the method of exchanging information with the outside can be divided into two types: Serial communication and parallel communication. Serial communication is slower than parallel communication, but it is easy to implement and long-distance transmission is possible. Therefore, communication for controlling the audio/video system is implemented through Serial communication. As a type of Serial communication, RS-232C, RS-422 and RS-485 are typically used [9, 10]. TCP communication and UDP communication are methods of exchanging information with the outside through a network. TCP communication is used in applications that require reliability because it does 3-way handshaking. UDP communication is used in applications that transmit simple data at a high speed because they do not confirm whether they are received.

3. Implementation of network-based audio/video integrated control system

NAVICS uses a Linux-based operating system (OS) to operate the device, and control of the audio/video system is possible through Ethernet and Serial communication. Communication via Ethernet can transmit and receive TCP/IP and UDP data. Serial communication can be connected up to 8 ports using RS-232. The OS of NAVICS is on the SD card, and the OS uses embedded Linux. The embedded Linux connection from the PC is accessed through Secure shell (SSH). File transmission to NAVICS allows program modification and file transmission and reception through File transfer protocol (FTP) or Samba. NAVICS coding the control signal processing coming in from the remote area and the audio/video device control having in the site through Python. The information necessary for signal processing was made possible to store and extract data through the SQLite-based database. Figure 3 shows NAVICS communication signal processing system schematic diagram. The Ethernet port of NAVICS can process transmission/reception signals of network-based audio/video devices and network communication with remote control devices. The Serial port of NAVICS is a port for controlling the audio/video device in the local space, and basically 8 can be connected. If there are more than 8 audio/video devices that perform Serial communication, it is possible to communicate with the device by additionally connecting NAVICS. The connection between NAVICS and NAVICS is possible with both Ethernet and Serial. The audio system is designed to output volume control and multiple audio sources by mixing through network-based OAC. The video system enables the control of matrix-type video output and device through the VMoIP Embedded system. The motor roll screen is able to control the screen device through the Relay board capable of Serial communication.

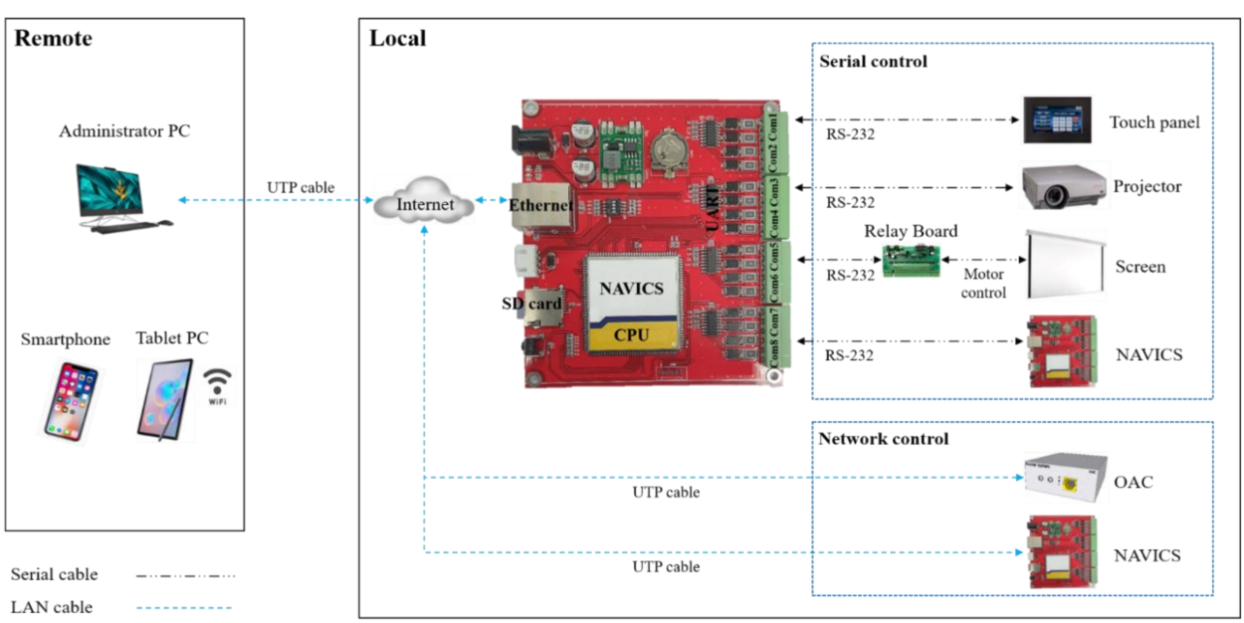


Figure 3. NAVICS communication signal processing system diagram

Navics can individually or collectively control audio/video devices that have recently been released on the market. In particular, it is a device suitable for Anchor system and VMoIP system control, and can control audio/video system without restrictions in place and time. In general, the control of device installed locally is controlled using a touch panel, and it is possible to control device remotely using a PC and mobile device. Figure 4 show a diagram configuring the control of an NAVICS-based audio/video system. The audio/video system configuration can control the audio/video device as a whole around NAVICS. Control of device indoors is possible using the touch panel of the control unit to control audio/video device. In the outside, the device control is possible by using the Smart device and Control PC. In the configuration of the NAVCIS-based audio system, the audio input and output device are connected to the HUB using OAC. HUB can transmit/receive and control audio signals by connecting with NAVICS. The configuration of the video system is connected to the HUB through LAN by installing the VMoIP Embedded system in the device of the video input and output sections. HUB is connected with NAVCIS to transmit/receive and control video signals. The VMoIP Embedded system can be connected to NAVICS through HUB to select the video source and specify an output path.

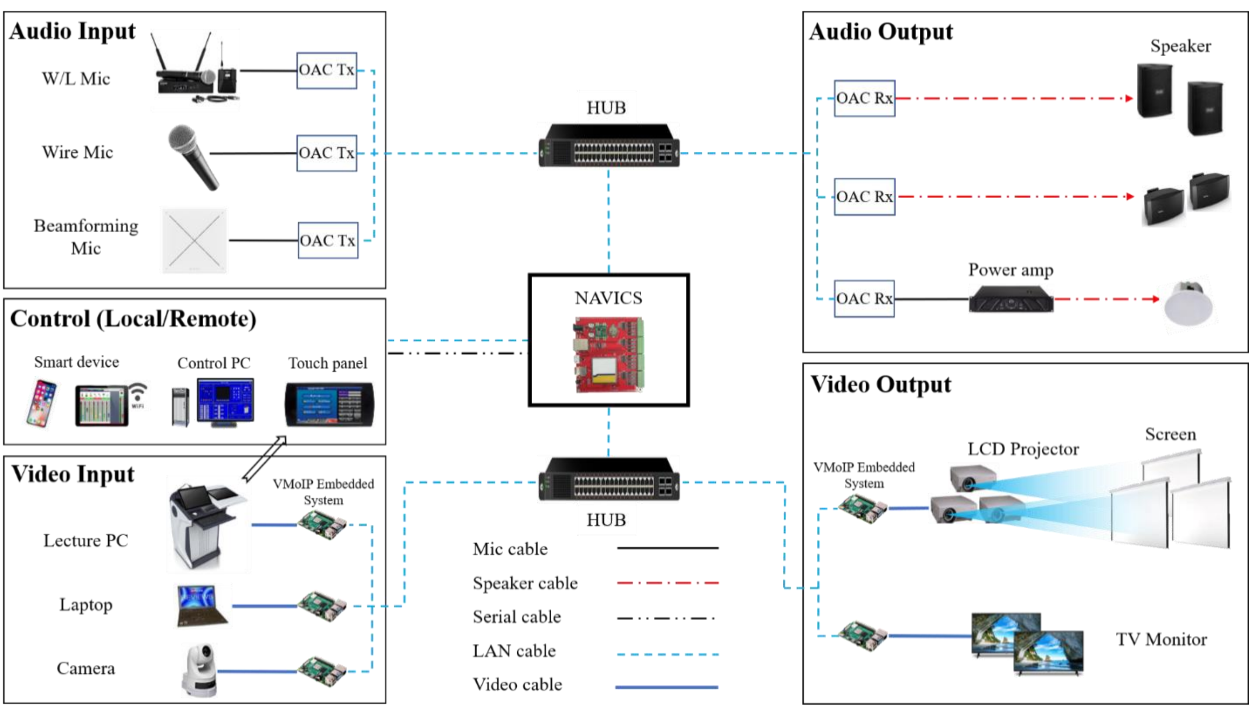


Figure 4. NAVICS based audio/video system control diagram

4. Experiment result of NAVICS

NAVICS is a CPU module equipped with NXP i.MX6 Ultra-Lite / 6 ULL processor based on ARM Cortex-A7 architecture, and the device operates using Linux-based OS. Figure 5 shows NAVICS CPU module diagram. NAVICS operating OS uses embedded Linux, and access to embedded Linux from a PC is through SSH. File transfer to NAVICS is done through FTP, or program modification and file exchange are made possible through Samba. NAVICS enables coding of control signal processing coming from remote locations and audio/video device control in local zones through Python, and information necessary for signal processing can be stored and extracted through SQLite-based database.

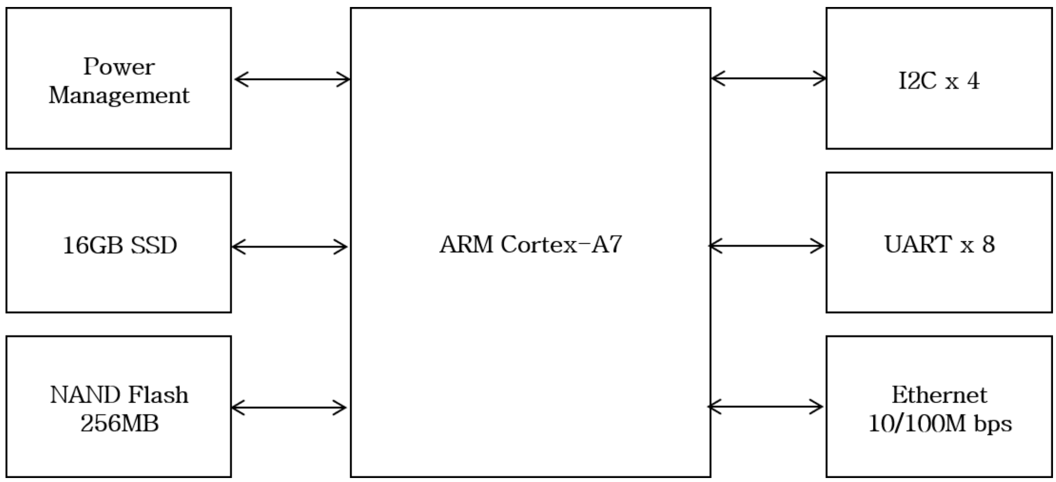


Figure 5. Diagram of NAVICS CPU module

Figure 6 show a schematic diagram of signal processing of NAVICS. NAVICS can communicate through Ethernet and Comport. In the data receipt procedure, the protocol of the transmitting device and the device to be controlled is divided, and the received data is recorded in the reception table of the database and the main procedure is called. The main procedure extracts related data for transmission from the database and calls the data send procedure to transmit the related data. Data send procedures transmit data (control protocol, status of each control device) sent by the main procedure.

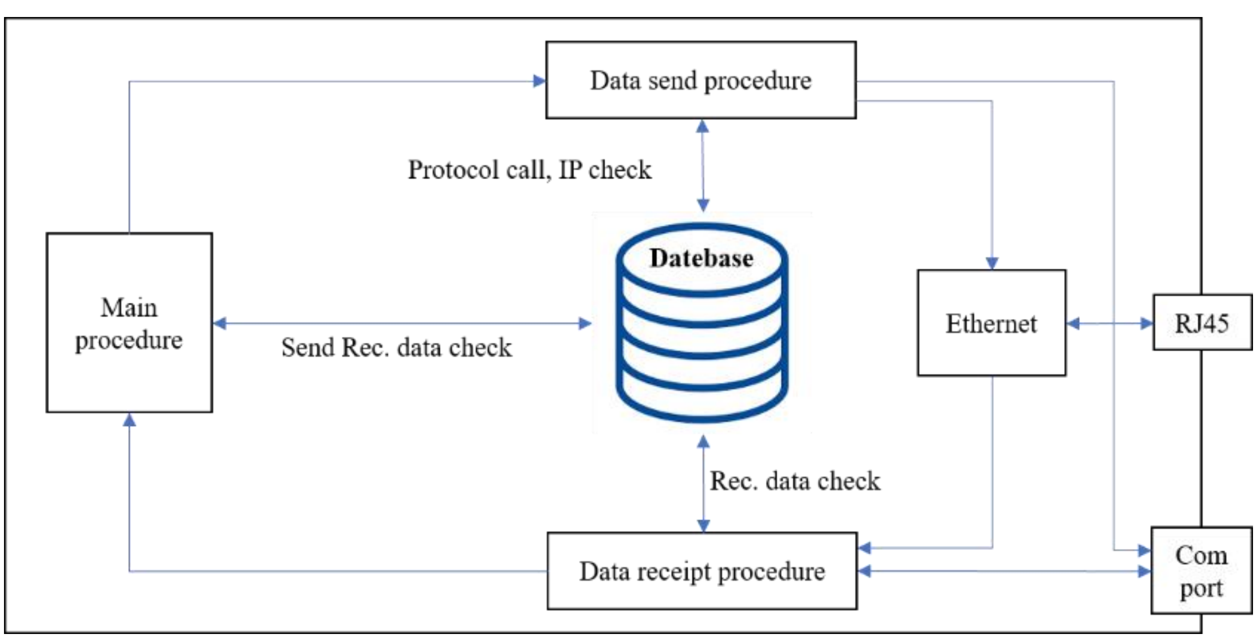
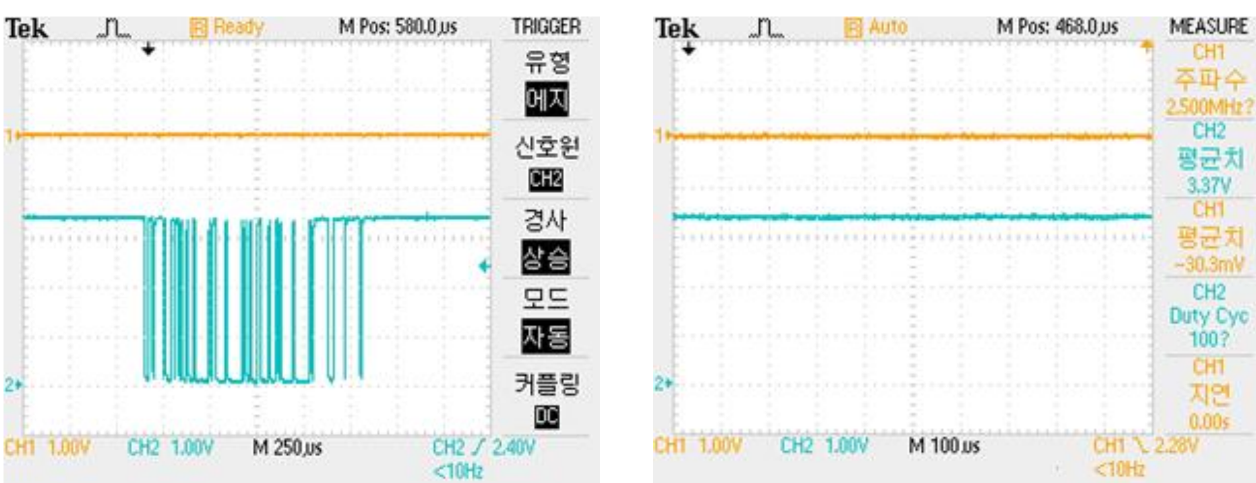


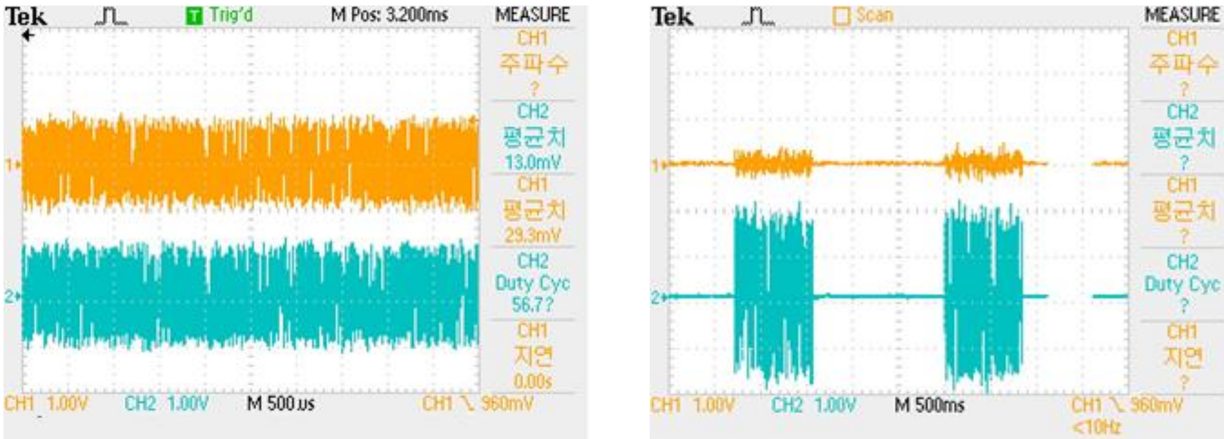
Figure 6. NAVICS control data processing system diagram

Figure 7 shows an experiment of data transmission/reception status through Ethernet and Serial of NAVICS. Figure 7 (a) shows the experimental results of data transmission status and standby status through Serial. (b) shows the experimental results of data reception state and standby state through Serial. (c) shows the communication status using Ethernet and the communication standby status. The horizontal grid in Figure 7 represents time, and the vertical grid represents voltage (with or without data transmission). The interval of the lattice representing the time is shown as 1 ms in the Serial Transmission Data experiment of (a) and 250 us in the Serial Reception Data experiment of (b). In the Ethernet communication data experiment of (c), 500 us is indicated. From (a) to (c), the intervals of the vertical grid are indicated by 1 V. The amplitude of the level indicates the ground (0 V) and trigger (3 V) operating levels.

(a) Serial communication transmission test data of NAVICS



(b) Serial communication reception test data of NAVICS



(c) Ethernet communication test data of NAVICS

Figure 7. Communication experiment data of NAVICS

5. CONCLUSION

In this paper, the following results were obtained as a study on a device that allows non-experts to control complex audio/video systems. First, the control of audio/video device was made to transmit and receive audio/video control protocol through network in local space and remote area using NAVICS, embedded device. If network communication is not possible or specific device uses Serial communication, it is possible to control audio/video devices. Second, the operation of the audio/video system allows integrated operation (Macro) and reserved operation of a number of audio/video device using PC, Tablet, Smartphone, Touch panel through GUI. In the future, it is hoped that the NAVCIS-based audio/video system will be more helpful in establishing a multimedia environment through this study. Also, it is expected to become a technical standard in operating and controlling audio/video systems.

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