



## Improvement of PC Hearing Support System: The Use of One-USB-OS

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### ABSTRACT

Sign language interpretation and PC captioning are commonly used as a means of assisting hearing impaired people to get information. A noise in the classroom is bigger than is expected, so it became a problem for those with hearing impairments, who had extra difficulty in listening in the classroom. Our earlier paper reported that we developed a supporting system of nursing care for the hearing disabled people, using a tablet PC and school LAN. This system also utilizes speech transmission on wireless LAN. Then, they can use their own smartphones and mobile games devices. The data showed its usefulness as a result of our monosyllabic intelligibility test. In the current project, we developed our earlier system into a new software-based system; the "one-usb-os" system. This new system enables users to run a USB start if they have a PC and to operate our proposed PC hearing support system. This paper reports the results of our measurement and describes acoustic characteristics observed in the actual noisy classroom environment.

Keywords: Sound, Classroom, Hearing I-INCE Classification of Subjects Number(s): 42

### 1. INTRODUCTION

The problems of children who require hearing support in school have been indicated. Currently, students having hearing impairment levels that range from mild to severe are studying at schools. Standards for classroom architectural planning and environmental management exist, but the classroom noise standards prescribed in the school environmental hygiene standards assume usage by non-disabled students[1-3]. To assess the compliance of those standards, an investigation of the classroom environments of hearing-impaired students has been reported[4,5]. Children who had previously attended special needs schools have become able to attend regular classrooms, but their academic performance may deteriorate when they are unable to hear the voices of their teachers. In classrooms, speech is infrequently transmitted to a child without interference from background noise. Background noise refers to any undesired auditory stimuli that interferes with what a child wants, or needs, to hear and understand. Background noise sources in the classroom include external noise (noise that is generated from outside of the building, such as airplane traffic, local construction, automobile traffic, and playgrounds), internal noise (noise that originates from within the building, but outside of the classroom, such as rooms adjacent to cafeterias, lecture rooms, gymnasiums, and/or busy hallways), and room noise (noise that is generated within the classroom). Sources of room noise include individuals talking, sliding of chairs or tables, and shuffling of hard-soled shoes on non-carpeted floors. Heating, ventilating, and air-conditioning (HVAC) systems usually also significantly contribute to classroom noise levels. Due to the myriad of potential sources of noise, classrooms often exhibit excessive levels of background noise. Systems are available that use existing technology to implement speech transmission via FM radio waves and deliver those transmissions to

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pupils and students[6,7]. Although such systems are commercially available, they have not become popular due to such issues as ease of use, problems of radio wave utilization, and pricing issues. The present paper reports on a developed hearing support system using a LAN-based voice communication system.

## 2. SYSTEM OVERVIEW

The noise levels generated in classrooms has been reported as ranging from 55 to 95 dB, which indicates a wide distribution of levels[4]. The approximate numbers of students having different degrees of hearing impairment are listed in Table 1, and those of students attending schools or classrooms specifically for hearing-impaired persons are listed in Table 2[8].

Table 1. Approximate numbers of hearing-impaired students

Conductive deafness	Mild sensorineural deafness	Sensorineural deafness	Total number
0.35%	0.54%	0.25%	1.13%
70,000	110,000	50,000	230,000

Table 2. Numbers students enrolled in special classes

No. of students at schools for the deaf	6719
No. of students in classes for the hearing-impaired	2199
Total	8918

As can be seen from Tables 1 and 2, most students are enrolled in regular classes.

Representative noise levels in classrooms are shown in Fig. 1. At these noise levels, hearing-impaired students have difficulty in hearing speech in a regular classroom, and as a result, their academic performance may deteriorate. As one solution to this problem, a system that uses FM wireless transmission has been used, and its effectiveness has been verified. The system reported in the present paper realizes two-way communication between a teacher and a student, rather than the one-way communication from teacher to student of the aforementioned FM wireless system, and has also been designed so as not to be overly expensive.

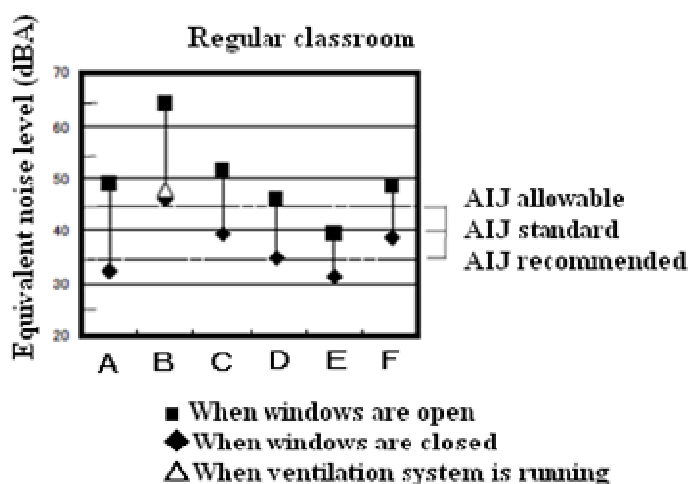


Fig. 1 Equivalent noise levels in regular classrooms

The newly developed hearing support system using a LAN environment is configured with a

Linux OS Web server. Figure 2 shows an overview of the system.

System functions include transmission and reception of voice packets, automatic acquisition and management of IP addresses of reception nodes, and a user interface.

The user interface that has been designed such that calls can be initiated or stopped and reception nodes can be managed by clicking a button located on a Web page. Accordingly, calls can be made in a familiar Web environment with simple operations.

When a reception node attempts to use this system, it first accesses the Web server and then the system is operated from the Web page that opens. At this time, information such as the IP address of the accessing reception node is stored at the server.

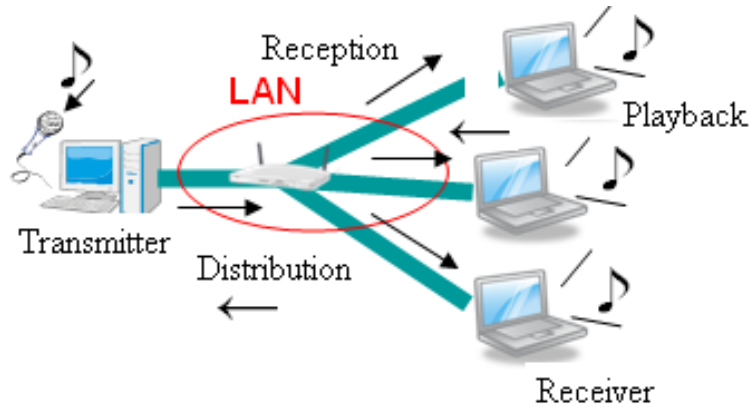


Fig. 2 Overview of the system

### 3. SYSTEM

The developed system uses Apache as the Web server software. Figure 3 shows the operational flow and the data flow within the system.

The RTP (Real-time Transport Protocol) transmission and RTP reception components shown in Fig. 3 are the components that carry out the voice communication. Because the user interface is provided on the Web, an applet with wide usability has been prepared.

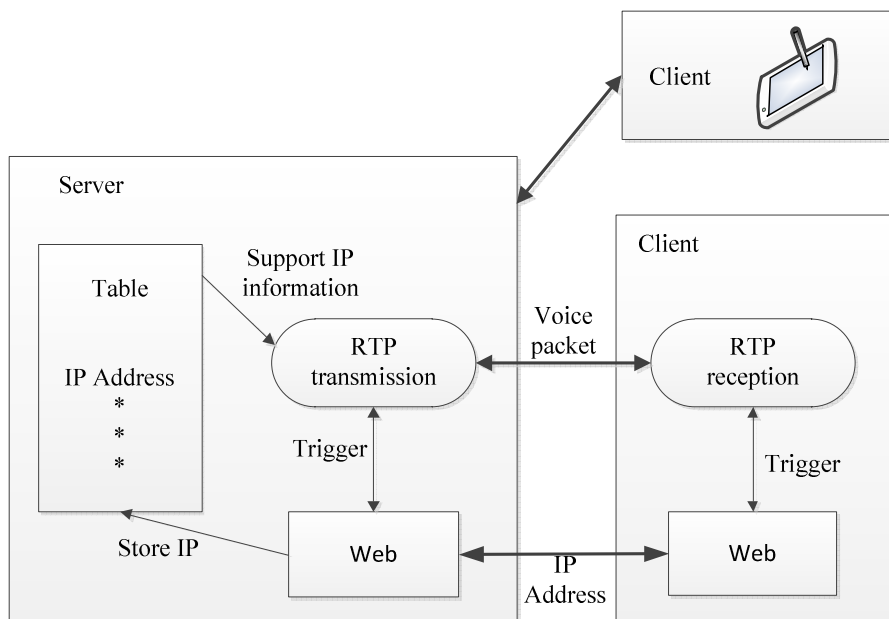


Fig. 3 Signal flow

To old this system, the applet is run in a Web browser. The applet is a Java program that is downloaded to the Web browser, embedded in the page of the browser, and then run[9,10].

The new developed system uses one-usb-Linux-boot software. For this purpose is new system, the applet was created in the Perl language and uses the web sound API, which is a sound-related API. And use sound-system.

In this study, we used a Linux of Ubuntu14.04LTS. It was attached to a control computer (Intel® i5 Laptop PC, 4.00 GB RAM) running Linux program. The USB that we used for an experiment is size of 8Gbyte.

We measured the acoustic feature of headphones. Figure 4 shows the Simulation of hearing. We were used simulator femtet2014.

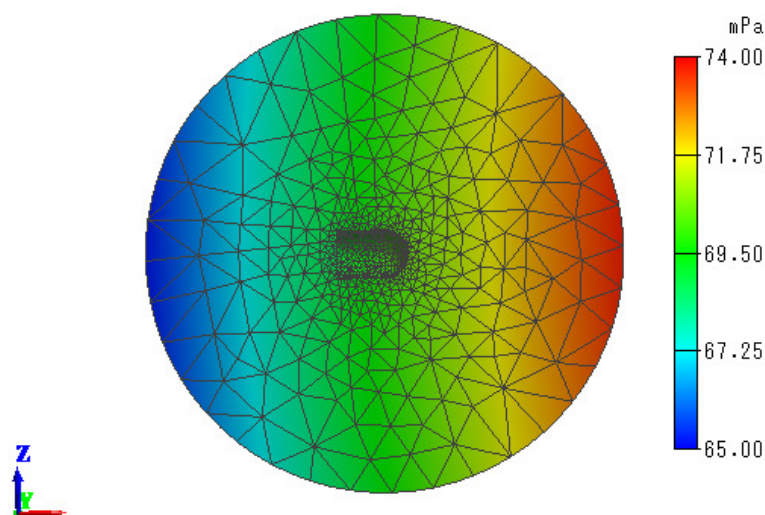


Fig. 4 Simulation of hearing

#### 4. CONCLUSIONS

The surprisingly loud noise environment found in classrooms is a problem for hearing-impaired persons and others who require concentration to listen. Moreover, it is not difficult to imagine that learning would be adversely affected if a teacher's voice were to be difficult for students to hear. For this purpose, products that use FM wireless transmission are commercially available. The system proposed in the present paper instead uses an existing LAN at a school. Because speech transmission is implemented via a wireless LAN, smart phones and portable game devices can also be used with this system. Use of these mobile devices enables the expense to be reduced. Of course, this system also supports the use of slate PC and notebook PCs.

For the system, a GUI that is easy to use for beginners and that requires few operations was adopted for the interface.

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