A Training System to Improve the Usefulness of Hearing Aids

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Abstract: An audio-visual system was proposed to improve the hearing ability of the hearing impaired, previously. It can make the hearing impaired notice phonemic cues by using vision together with hearing. In the preliminary experiments by a hearing impaired person with prototype hearing aid, it was noted that the information of visualized speech could contribute to combine sound images and their understanding as phonemes[1]. To generalize this method for other applications, a new type of training system is proposed. The system consists of a personal computer, audio equipment and CD-ROM which contains training programs and data. The system provides speech signals and visualized speech together for a trainee, automatically. All the information for the training are stored in CD-ROM. The word samples, visualized speeches and training programs are prepared for the training.

THE TRAINING SYSTEM AND ITS METHOD

When the hearing impaired start to use new type of hearing aids or when persons start to hear sound of speech for the first time with the help of a new equipment such as a cochlear implant, there is a need to let him/her understand what the sounds mean. In those cases a proper training should be presented to improve the effectiveness of the aids. This training system intends to let him/her combine sounds and phonemes by himself/herself. To accomplish the purpose, the method for speech visualization is adopted to find phonemic cues for the trainee. This method uses visual information to understand the speech signals. Speech parameter's extraction, spectrum analysis and processing by neural networks are used to obtain visualized speech[2]. The system for this training is shown in FIGURE 1. The system structure is very simple, but the information of visualized speech can be analyzed by the trainee, and expected to present new type of helps for them to understand phonemes. The real-time presentation of visualized speech requires a multi-DSP system for speech parameter’s extraction and synthesizing image of speech as a combination of colors and patterns. As for training all the sample data are prepared beforehand and no special hardware is needed. The sample sounds for the training is converted into visual images and stored in CD-ROM as shown in FIGURE 1. In the system visualized speech is presented on the screen together with speech sound to their ear.

FIGURE 1. A training system to improve the usefulness of hearing aids
A flowchart of the training is in FIGURE2. In the first place the level of concrete objectives are considered by hearing tests. The sample of speech signals are presented to the trainee through the aids of their own. The level of the objectives should be decided by investigating for what sounds he/she finds difficult to understand. After deciding the objectives of one training, brief study for visualized speech will be carried out. Visualized speech patterns and characters could be shown on the screen when he/she listens to the example sounds. Although the visualized speech can be read with no characters, the characters accelerate the practice of reading the visualized speech. The correspondence of sounds and visualized speech are examined by subjective evaluation of the trainee after the explanation.

When the training starts, several groups of training samples will be used. The sounds samples and visualized speech with characters are picked up from the database of CD-ROM and presented to the trainee. This provides the confirmation of reading the visualized speech and hearing results. In the training, the visualized speech and characters come out to the screen and stops at the center while speech sounds are repeated several times for the trainee to study the sounds. In next process, characters will not be displayed on the screen. The trainee tries to grasp the image of the sounds with the help of visualized speech. The visualized speech is aimed at complete representation by which people can read any word or short sentence pronounced by anyone[2]. He/She can predict the existence of the phonemes based on results of reading the visual information, even the sounds still could not be understood in the early part of the training. The trainee can try to grasp the sounds by the help of visualized speech. In the very last stage of the training, only speech signals are presented. And the correct answers are checked. If satisfactory results are obtained comparing with the training objectives, one set of training will be finished. In case if the scores do not show enough improvement, then training is repeated. The results of experiments with a single resonant analysis type of hearing aid, which are conducted with hearing impaired persons, will be discussed in the session.

**SUMMARY**

To improve the usefulness of hearing aids and other new kinds of aid, such as a cochlear implant, we proposed a training systems based on CD-ROM. More than 2000 words of speech signals, visualized speech and training programs are stored in one CD-ROM. Visualized speech is presented to a color monitor while the system presenting speech sounds to the trainee. The system requires no special hardware, but only a D/A interface to present speech signals to the trainee. The training system for the a single resonant analysis type of hearing aid is generalized successfully for other kinds of hearing aids without special hardwares.

**REFERENCES**