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Voice Capture Device, Voice Capture Method, and Program

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MRI equipment room

Overview of the technology

This invention is a technology developed to clearly obtain voice produced by a subject being measured by using MRI (magnetic resonance imaging) equipment for the purpose of brain information research. MRI equipment uses a powerful superconducting magnet to quickly change the magnetic field in taking pictures, so that a strong pulse-like current flows through the coil. Subsequent coil vibrations generate intense MRI equipment noise and electromagnetic induction noise, along with other types of noise. Consequently, it has thus far been impossible to clearly obtain voice produced by the subject while operating the MRI equipment. This invention is an idea conceived as one solution to address that problem. As shown in Fig. 1, two microphones are provided: mic 1 and mic 2. Mic 1 is used to pick up the voice of the subject, sound noise, electromagnetic induction noise, and other types of noise. Mic 2 is used to capture sound noise, electromagnetic induction noise, and other types of noise. A filter is used in estimating the sound noise and electromagnetic induction noise picked up by mic 1 from the waveform data obtained by mic 2, in order to conduct noise cancellation. This may be sufficient to clarify the voice of the subject, but the noise environment is typically so severe as to preclude adequate cancellation effects. Therefore, averaging is also conducted to cancel the high-frequency component of residual noise. These operations make it possible to clearly obtain the voice of the subject. Moreover, mics 1 and 2 have lower sensitivity to

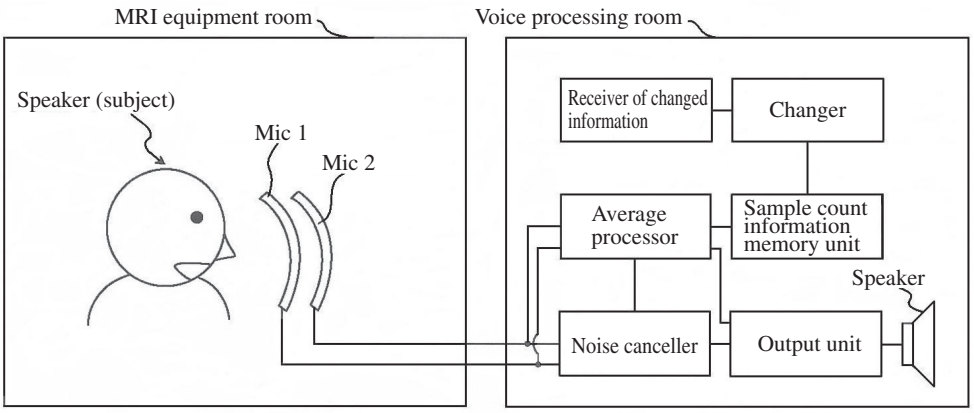


Fig.1 Configuration of noise cancellation equipment in this invention

noise and are placed closer together in order to facilitate noise cancellation. Moreover, mic 1 is constructed to capture the voice of the subject with higher sensitivity, thereby achieving a higher effect. It is also possible to conduct noise cancellation with mic 1 alone. The removal of these types of noise and electromagnetic induction noise can also be conducted using digital signals on a PC.

Practical implementations of noise cancellation

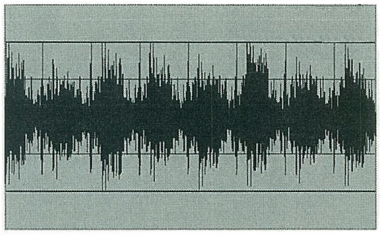
Conversing with the subject during a brain scan using MRI equipment is an important method of experimentation in brain information research. This is because "conversing" in this case not only entails the researcher giving certain instructions to the subject but also, for example, monitoring the subject's reactions and feelings based not only on verbal response but also on the subject's intonation and/or other signs when the subject is given visual or especially audible stimulation. MRI equipment generates noise that exceeds 100 dB (equivalent to the sound level heard under an elevated railroad when a train passes by) during measurement operation. Such a state makes normal conversation impossible. This has prompted a consideration of methods for canceling the various types of noise.

Next, an example of noise cancellation in severe noise environments is shown. Fig. 3 (a) shows a raw signal waveform (via mic 1) with no noise cancellation conducted. Rough monitoring of the waveform reveals that it is a repetition of a periodic pattern with sharp spike-like noise and a cycle of less than 0.1 second. Here, canceling the noise and induction noise in mic 1 with mic 2 inhibits the noise peak as shown in Fig. 3 (b), thereby somewhat reducing the noise. Moreover, the averaging mentioned above reduces the noise component considerably as shown in Fig. 3 (c). Fig. 4 shows the noise-canceled voice of the subject and the canceled noise level. Thus, the method employed in this invention enables voice signals of the subject to be clearly picked up.

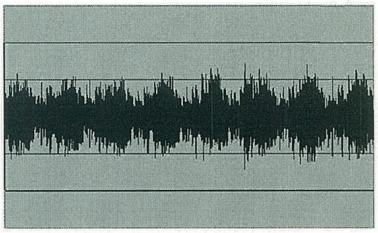
Input signals are A/D converted and stored as data on the PC. These noise cancellation operations therefore allow averaging and other parameters to be subsequently changed and reproduced. It is therefore possible to try the optimum states many times later on.

In order to enable use in a powerful magnetic field, the entire headset is also made of a material that does not react to the magnetic field and the signal line is heavily shielded.

Fig.2 External view of headset



(a) Raw waveform including electromagnetic and other types of noise



(b) Waveform after noise cancellation

(c) Waveform after averaging

Fig.3 Example of noise cancellation in this invention

Commercial availability

A product based on this noise cancellation technology is sold by Hitachi Advanced Systems Corporation under the product name "Conversation System for MRI equipment" as a combination of a non-magnetic headset with a data processor.

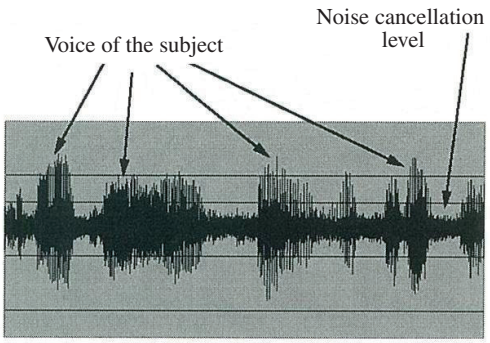


Fig.4 Waveform after noise cancellation

Conclusion

We look forward to the day when this equipment becomes widely used to enable clear conversations between the brain information researcher and subject, thus helping to elucidate the still largely unknown mysteries of the brain.

(Article written by SAWADA Fumitake, Expert, Intellectual Property Management Group, Research Promotion Department)

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