

A Study on a Automatic Audiometry Aid by PSM

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Abstract

The five senses of the human body are essential sensory organs for human life. These sensory organs are completed through the growth period and begin to decline through middle age. However, if we manage ourselves thoroughly, we can delay the time of its decline as much as possible. Among them, the hearing organ has recently been advancing the age of degeneration regardless of age due to the increasing noise of life and the use of loud earphone volume. In this paper, we have studied the development of an automatic audiometry aid using pulse sequence Method that can easily and conveniently measure hearing in order to preserve the hearing function even in the environment where such poor hearing impairment is concerned. For hearing protection and management, it is necessary to check hearing from time to time. The frequency and sound level ranges for hearing tests are divided into nine sections, from 100 Hz to 10 kHz, which are the audible frequency bands commonly accepted by the owner of healthy hearing, and the sound levels for each frequency are divided into -3 dB, -10 dB and -30 dB. The subjects were divided into two groups. The results for hearing measurement were set to be measured from 10 to 60 or more. It is recommended that the automatic hearing measurement device developed through this study be used as a portable personal hearing measurement device or smart phone application.

Keywords : the five senses, hearing, hearing loss, pulse sequence method, hearing protection, Automatic Audiometry Aid, applications

1. INTRODUCTION

With increasing interest in quality of life, various methods of health care are being sought. Among them, the importance of hearing is also attracting attention. As the media environment grows in proportion from images to sound, there is a social atmosphere where hearing loss is feared due to adverse effects. As people watch video at too high a level or hear a lot of headphones or earphones, the age range of people with hearing impairment is getting lower. In the meantime, in order to manage our hearing, most of the time, when we receive a health check once a year, we will be audited by proceeding with other examinations in order. In addition to this, there are few opportunities to perform hearing tests, and hearing test methods have also been performed using specific test equipment in a soundproof room in a hospital or health examination center. However, if you are aware of the importance of hearing management, I would argue that you should test your hearing from time to time and monitor it thoroughly. Frequent hearing test habits will give more attention to your hearing and thereby create an environment and lifestyle that protects your hearing. In this paper, we propose an automatic hearing test system which can test the hearing ability more conveniently and easily as a way to customize the hearing management. This method is an automatic hearing test method using a pulse sequence. It generates a three-step sound pressure pulse at nine frequency points where a human body reacts to automatically measure hearing. Such an automatic hearing test system can measure the hearing ability of an individual person easily and can be easily utilized in an ear infirmary and a medical examination center of a small clinic and a university hospital.[1][2]

2. HEARING THEORY

The auditory sense of the human's ear recognizes 400,000 sounds according to the sound pressure frequency and the physical quantity of the sound generating object, and recognizes the frequency from 20Hz to 20kHz and senses the pressure up to 100dB. The auditory organ of the human body is largely divided into the outer ear, middle ear, and inner ear. The outer ear includes the ear canal, outer ear canal, and ear drum. The middle ear has a hammer bone, ankle bone and back bone. The inner ear has a basement membrane. In the middle section, the bones connected to the eardrum are used as a zodule reverse bulb and amplify the eardrum vibration three times, and the sound is transmitted to the semicircular canal for balancing the body and the cochlea and the auditory nerve per each frequency band. The cochlea is converted to an electrical signal through the auditory nerve cells of the basement membrane and transmitted to the brain to be perceived. Sound waves gathered from the auricle and entered into the ear canal shake the eardrum, and the vibration is connected to the skeleton and the eardrum connected to the eardrum to transmit sound and be transmitted to the auditory nerve of the brain to recognize the sound. In the semicircular canal, it is responsible for the balance of the body. In the cochlea, sound can be perceived by the frequency through the lymphatic fluid and the auditory nerve. If the structure and function of the ears are maintained in a healthy state, the hearing

hearing measurement methods: subjective tests performed under the promise of patients and objective tests obtained as judgments by hearing test equipment. Subjective tests include phonetics test, pure tone hearing test, speech audiometry, magnetic audiometry, personality test, and audiometric fatigue test. Objective tests include impedance hearing test, electroencephalogram, auditory brainstem response audiometry. The most basic hearing test is pure tone hearing test, audiogram test, impedance hearing test, and hearing test. and, If hearing test results show abnormalities, another precision hearing test is carried out. Among them, the basic hearing test that is universally applied in general health screening is pure tone audiometry. Pure tone audiometry is a test that measures the hearing ability of a hearing examinee by adjusting the amplitude of the sound at each frequency by generating the tones generated at each frequency step by step. However, the purity test has limitations in the time, place and method of visiting hospitals and health check centers, wearing headphones in the soundproof room and receiving reception from inspectors in a very cumbersome way. These limitations can cause errors that must be kept in a neglected state because the hearing needs to be checked and maintained from time to time and must use a particular device at a certain time and place. In this sense, this paper proposes a system that can automatically measure his or her hearing anytime and anywhere freely from the limitations of existing hearing measurement methods. The hearing measurement method proposed in this study is a method that can automatically measure and manage his or her hearing ability anytime and anywhere.

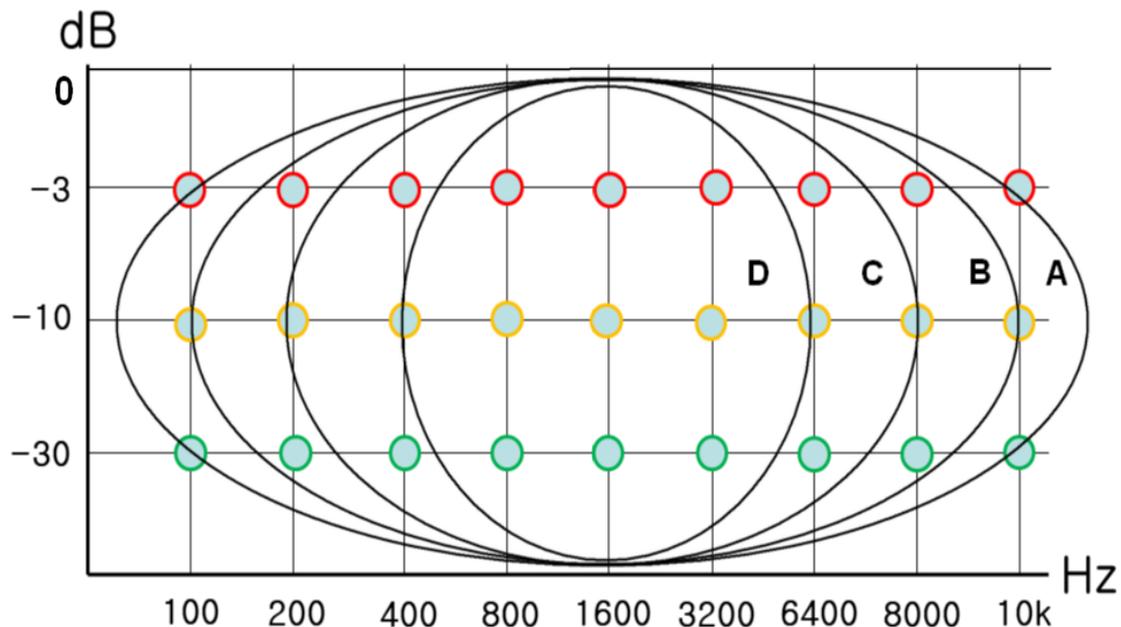


Figure 2. Audible level decision graph by hearing frequency level rating

First of all, you should be able to measure your hearing ability at any time by transferring the pure tone hearing measurement method operated by a hospital or health monitoring center to your personal computer or your own mobile. It is necessary to divide the pure tone for hearing measurement appropriately into a normal audible frequency range of a normal person. In addition, it is necessary to generate several degrees of pure tone of each frequency divided for inspection. The reason is that you can recognize when the sound level is high even at a frequency that can not be detected. In addition, the recognition status of each sound level of each frequency should be programmed so that it can be evaluated based on the normal situation. The proposed automatic hearing test system is divided into frequency points of nine zones in the range of 100Hz to 10kHz, which is the common listening area of normal people in the human audible frequency band. The level of the sound level is also measured in three steps of -3dB, -10dB, and -30dB. In other words, this automatic hearing measurement method is an automatic hearing test system based on a pulse sequence. In general, the hearing loss is reduced at low frequencies (1,600 Hz) and in the high frequency range (Fig. 2). A can be classified as "normal", B as "interest", C as "caution", and D as "warning". If the audiologist does not hear more than 8 sounds, he / she should be careful about hearing management by judging it as a stage of interest. If you do not hear any more than five sounds, you should go to the hospital, get medical care, check the condition, and get the appropriate treatment.[6][7][8]

4. HEARING TEST

The audiometry was performed using the automatic hearing meter proposed in this paper. The subjects were asked to listen to nine frequency tones for three people each from 10 to 60s for about 20 seconds at intervals of 1.5 seconds per 1 second. This process was performed in the order of -3dB, -10dB, and -30dB. The measurement results were averaged to determine the age and hearing health status. Table 1 shows the average audiometric measurement results by age group. In 10th and 20th generation, normal hearing results were obtained by normal sounding of 9 frequencies at all 3 levels. Though they are older than their age of growth, they may have had more opportunities to interact with the media, but at the -30dB level, they had difficulties in receiving low frequency and high frequency bands and showed interest in hearing management. 40s showed hearing results that they should be interested in hearing management because of difficulty in receiving low frequency 100Hz and high frequency 10kHz band at two sound level levels of -10dB and -30dB. This phenomenon can be seen as the beginning of hearing aging phenomenon. The more you do this, the more you will have to pay attention to hearing care. 50s showed difficulty in receiving at low frequencies of 100Hz, 200Hz and high frequencies of 8Hz and 10kHz at both sound levels of -10dB and -30dB, proving the age to pay more attention to hearing management.

Table 1. Average results of audiometry by age group using automatic audiometry

Age \ dB \ Hz	100	200	400	800	1600	3200	6400	8k	10k	result
10' s	-3dB	o	o	o	o	o	o	o	o	normal
	-10dB	o	o	o	o	o	o	o	o	
	-30dB	o	o	o	o	o	o	o	o	
20' s	-3dB	o	o	o	o	o	o	o	o	normal
	-10dB	o	o	o	o	o	o	o	o	
	-30dB	o	o	o	o	o	o	o	o	
30' s	-3dB	o	o	o	o	o	o	o	o	attention
	-10dB	o	o	o	o	o	o	o	o	
	-30dB	x	o	o	o	o	o	o	x	
40' s	-3dB	o	o	o	o	o	o	o	o	attention
	-10dB	x	o	o	o	o	o	o	x	
	-30dB	x	o	o	o	o	o	o	x	
50' s	-3dB	o	o	o	o	o	o	o	o	caution
	-10dB	x	x	o	o	o	o	x	x	
	-30dB	x	x	o	o	o	o	x	x	
60' s	-3dB	x	o	o	o	o	o	o	x	warning
	-10dB	x	x	o	o	o	o	x	x	
	-30dB	x	x	x	o	o	o	x	x	

In the 60s, the three levels of the low-frequency of 100Hz and the high-frequency of -3dB, -10dB, and -30dB of 10kHz showed difficulty in mawing. At 200Hz and 8kHz, the two levels of levels of -10dB and -30dB At 400Hz and 6,400Hz, hearing difficulty in the level of one level of -30dB showed that the aging process was quite progressive, which was a warning step in hearing management.[9][10][11]

To test the automatic audiometry, nine frequencies from 100Hz to 10kHz are extracted and the volume level grades are divided into three levels of -3dB, -10dB, and -30dB. Hearing test was performed by giving. Hearing test results were recorded by classifying each line by age group on audiogram level judgment graph by hearing measurement frequency level class. Figure 3 shows a graph of the audiences for each age group. First, when you look at the 60th line, you can detect the sound at a volume level of more than -3dB in the low frequency band of 100Hz and the high frequency band of 10kHz, and it was able to sense sound at the volume level exceeding -10dB at 200Hz and 8,000Hz. In the frequency range of 400Hz and 6,400Hz, the sound was able to be detected even at the level of -30 dB or less. However, since we could detect no more than 5 frequency sounds at a volume level of less than -30dB, we need to visit the hospital regularly in order to check the hearing level.

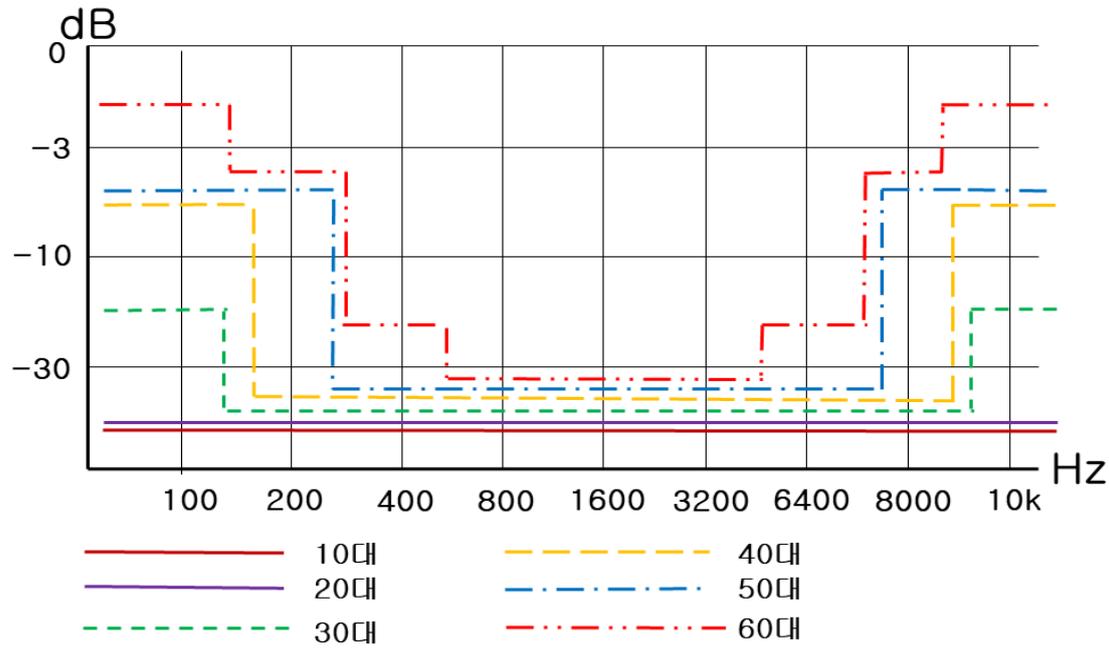


Figure 3. Graph of Audience Level by Age Group

50s were able to receive low frequency bands of 100Hz and 200Hz and high frequency bands of 8,000Hz and 10kHz at a volume level of more than -10dB and the frequency sound of 400Hz to 6,400Hz could be received at less than -30dB. However, although we detected only 5 frequency sounds at a volume level of less than -30dB, we could detect 9 frequency sounds at -3dB level. 40s were able to detect the frequency sound of the low frequency band of 100Hz and the high frequency band of 10kHz at more than -10dB. However, at the -3dB level, all 9 frequency bands are detected. 30s were able to detect the frequency sound at -10dB or more in the low frequency band of 100Hz and the high frequency band of 10kHz, but at the -3dB sound level, they detected all nine frequency sounds of all the bands. 20s and 10s were able to detect all nine frequencies ranging from the low frequency band of 100Hz to the high frequency band of 10kHz, so that it was judged that they have normal hearing power.

5. CONCLUSION

The automatic hearing measurement system proposed in this paper is an improved method to automatically and easily receive hearing tests that can be received only once or twice a year, at any time, anywhere by visiting a conventional hospital or a health examination center. The hearing measurement time of this automatic hearing measurement device is less than 5 minutes and can save much time compared to other inspection methods. Compared with the conventional method of manually inspecting the hearing, the accuracy is also high. This automatic hearing measurement system is a system that can reduce the misdiagnosis due to the machine malfunction of the

hospital or the examination center and the inexperience of the machine operation of the inspecting personnel, and can perform a precise examination within a few minutes. This automatic hearing measurement system divides the audible frequency range, which can be taken by all normal persons, into nine levels from 100 Hz in the low-frequency range to 10 kHz in the high-frequency range and divides the volume levels of the respective frequencies into three levels of -3 dB, -10 dB and -30 dB I used it as a measurement standard. The measurement method is to listen to 9 frequency sounds with a volume level of -3dB first, check the detected frequency sound, and then, in the same way, listen in the order of -10dB, -30dB, check the number of detected frequency sound, It is a way to judge. Each frequency sound is generated in about 1 second. The interval between two frequencies is one level. It takes about 25 seconds when all nine frequencies are heard. If you provide another interval of 5 seconds, It only takes about 1 minute and 30 seconds. If you use this method, you will have enough time to finish all the records related to the hearing test and it will be enough for 5 minutes. In addition, if you can implement 9 frequency sound levels corresponding to the normal audible frequency range required for automatic hearing measurement at the 3-level volume level, you can measure your own hearing anytime and anywhere. In the future, if this automatic hearing measurement method is widely used, people will be more interested in managing their own hearing. The proposal of this system will play an important role for the hearing health of the people.

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