ABSTRACT

In this paper, hearing disorders are classified into various categories according to the anatomy of the ear that explains various parts of ears. Hearing disorders are categorized according to part in which hearing problem comes. This paper helps in classifying hearing disorders with the help of various algorithms that are based on wavelet packets and support vector machine, artificial neural network, DPOAE, modified back propagation network. Besides of many algorithms available, it’s still very challenging to detect type of hearing disorder.

Keywords: Conductive Hearing Disorder, Sensorineural Hearing Disorder, Transient Evoked Otoacoustic Emissions (TEOAE), DPOAE, modified back propagation network.

1. Introduction

In today’s context, hearing disorders are common in diverse population as there is noise pollution, accidental incidence and genetic reasons for such development therefore there is an urgent need to use algorithms which can come aid to medical practitioner for helping them in diagnose of hearing disorder and classify its types, since identifying what type of hearing disorder is challenging task and specially for fresh medical practitioner in this access paper of we conduct survey of hearing disorders, challenges involved in identifying the different class of hearing disorder and the role of classification of algorithm for diagnosis of hearing disorder and classification of their types.

1.1 Anatomy of the Ear

The ears are paired sensory organs comprising the auditory system involved in the detection of sound, and the vestibular system, involved with maintaining body balance/ equilibrium. The ear divides anatomically and functionally into three regions: the external ear, the middle ear, and the inner ear. All three regions are involved in hearing. Only the inner ear functions in the vestibular-system.

2. Types of Hearing Disorders

There are four types of hearing disorder, as follows:

2.1 Conductive hearing disorders are caused by diseases or obstructions in the outer or middle ear (the pathways for sound to reach the inner ear). These hearing disorders can range from mild to moderate.[5] Some of the factors that can affect conductive hearing disorder include:
1. Fluid build-up in the middle ear due to the flu, allergies, or infection, which prevents the ossicles from properly transmitting ear drum vibrations to the inner ear.

2. Any type of obstruction in the ear canal, such as wax build up or a foreign object.

3. Any infection of the ear canal that causes the canal to swell and partially or fully close.

4. Poor eustachian tube functioning so that pressure cannot equalize between the middle ear and outside air.

5. Congenital birth defects such as poor formation of the middle or outer ear.

![Figure 1: Anatomy of the Ear](image)

**2.2 Sensorineural hearing disorders** result from damage to the delicate sensory hair cells of the inner ear or the nerves that supply it. These hearing disorders can range from mild to profound.[5] They often affect the person’s ability to hear certain frequencies more than others. Thus, even with amplification to increase the sound level, a person with a sensorineural hearing loss may perceive distorted sounds, sometimes making the successful use of a hearing aid impossible and difficult. Sensorineural hearing disorder may not only reduce a person’s ability to hear faint sounds, but may also reduce a person’s ability to hear clearly or understand speech. Sensorineural hearing disorder is often permanent and cannot be medically or surgically treated. Common factors that can cause sensorineural hearing loss include:

- Drugs that poison the auditory nervous system or auditory area of the brain.
- Excessive and prolonged exposure to loud sounds.
- Congenital birth defects where the inner ear, auditory nerve, or auditory area of the brain are malformed.
- Direct damage caused by head trauma or tumors.
2.3 Mixed hearing disorder refers to a combination of conductive and sensorineural disorder and means that a problem occurs in both the outer or middle and the inner ear [5]. These hearing disorders can range from mild to profound. The cause of mixed hearing disorder is Combination of conductive and sensory causes

Central hearing disorder results from damage or impairment to the nerves or nuclei of the central nervous system, either in the pathways to the brain or in the brain itself. These hearing disorders can range from mild to profound [5]. The cause of central hearing disorder may be due to head injury, tumor or heredity / genetics.

3. Role of Algorithm in Classifying Hearing Disorders

3.1 Wavelet packets and support vector machines:
In this, an application of wavelet packet transformation and support vector machine is used for detection of persons having different degree of hearing disorder which include normal hearing, high frequency hearing loss, pantonal hearing loss, the result of this paper have been promising and the test are in this paper is Transient Evoked Otoacoustic Emissions (TEOAE)[1] that is done on cochlea's outer hair cells when a normal middle ear is present. A series of transient stimuli (wideband clicks or chirps) are sent into the ear canal. The resulting TEOAE, coming from the inner ear through the middle ear, is measured in the ear canal between stimulus presentations. In less than a minute, a wideband assessment is achieved.

3.2 Neural network model for optimizing vowel recognition by cochlear implant listeners:
In this, artificial neural network has been used for recognizing vowels for those patients who are using hearing aid in this research, they are suggesting usage of neural network for enhancing the reorganization of this machine which is called cochlear implant.[2] A neural network consists of an interconnected group of artificial neurons, and it processes information using a connectionist approach to computation. In most cases an ANN is an adaptive system that changes its structure based on external or internal information that flows through the network during the learning phase. Modern neural networks are non-linear statistical data modeling tools.

3.3 DPOAE techniques and classifiers:
In this, the entire focus for classifying hearing problems is based an features abstraction of the subjects gone through Otoacoustic emissions. So in this, amplitude and latency are main testing factors for identifying having problem and their test result are subjected to k-means and artificial neural network techniques.[3] An otoacoustic emission (OAE) is a sound which is generated from within the inner ear. Studies have shown that OAEs disappear after the inner ear has been damaged, so OAEs are often used in the laboratory and the clinic as a measure of inner ear health.

3.4 Modified back propagation neural network:
In this, Researcher has been done for subjects who have been exposed to noise pollution to such extent that they loss hearing capacity. In this research paper, they are trying to predict at what point the person will have permanent loss of hearing if he continues to be expose to noise pollution. This is done by using modified back propagation network algorithms. BPNN learns by calculating the errors of the output layer to find the errors in hidden layers. Due to this ability of back propagating, it is highly suitable for problems in which no relationship is found between input and outputs The gradient descent method is utilize to calculate the weights and adjustments are made to the network to minimize the output error.[4]

4. Conclusion and Future Scope
For doctors it is a challenge to find which hearing disorder class is the person suffering from even if the know empirically by conducting various test that the person is suffering from a auditory problem. Therefore, to detect hearing disorder, it is necessary to develop a survey to understand what hearing disorder is and to develop a representative data set of hearing disorders. Then, to detect class of hearing disorder with high accuracy, it is
required to create a classifier according to the results that helps the doctors to detect right class of disorder correctly.

References


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