Bekesy Test for Mobile

By

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Executive Summary:

We are designing a hearing test mobile app that attempts to accurately model professional Bekesy audiometry, for Dr. Douglas Oliver. The Apps that are currently available on the various online stores bear little resemblance to the accuracy of a professional audiogram. Thus far, there is no mobile phone application that has the ability to reliably identify hearing loss in a subject. This is due to a lack in normalized threshold over which to accurately measure a subject’s hearing. Essentially there is no App that reproduces Pure Tone Audiometry (PTA), which is used to identify degree, type and configuration of a hearing loss.

Introduction:

At the most basic level an audiogram is a screening test like that which is used in schools. A series of tones at fixed volumes are presented to the listener who then indicates which ones he or she can detect. PTA is a subjective and behavioral measurement of hearing threshold, because it relies on patient initiation of a response to acoustic stimuli. PTA is designed for clinical use on adults and children old enough to understand and execute the test procedure. Like the majority of clinical tests, calibration of the test environment, the equipment and the stimuli to ISO standards is pivotal, as PTA measures thresholds of hearing only (in contrast with other methods which delineate sound localization).

The vast majority of mobile apps on the market today are frequency range tests. These tests are much like the basic test described above. Many present upwards of 20 different tones and asks the user whether or not they can hear them. Generally these apps tell you your “hearing age” or otherwise similar (but arbitrary) assessments.

A patent search produced nothing of note. There are no patents for mobile apps modeling the Bekesy audiometry technique.

Project Description:

2.2 Objective

We propose a software application, designed for mobile devices, that performs an accurate and efficient test of auditory stimulus response. The results will be comparable to a clinical audiogram, designed to determine the threshold of hearing at each frequency being tested. The user will begin by identifying the type of headphone he/she is using, choosing from a list of headphone varieties and possibly models i.e. over-ear, ear-buds.

Methods 2.2
The fundamental concept behind the Bekesy audiometer is that the patient records his or her own threshold automatically on an audiogram black. When the audiometer is turned on, a pure tone at a midrange frequency will come through the earphone. The subject will control the intensity of the stimulus by pressing a button while listening to a pulsing (0.5s) pure tone whose frequency slowly moves through the entire audible range. This is what is called an “interrupted” tone. The intensity diminishes as long as the button is depressed. When the intensity is too low for the subject to hear the tone, the button will be released and the intensity will start to increase. When the subject again hears the tone, the button will be pressed again, producing a zigzag trace. The test will involve diagnostics on each ear, after which the tracings of both the left and the right ear will be compared. The test will be usable to differentiate between cochlear and neural hearing losses.

Because of the importance of having the calibration of the headphone and output jack be constant across all users of the app, the mobile platform chosen for the development of the app is Android Platform, using the wildly popular Google Nexus 7 Tablet. Due to the widespread use of Apple ear buds, the app will be calibrated according to the ear buds and Nexus 7 combination. Such uniformity is not so apparent in Android phones, due to the variety of manufacturers (and likewise headphones and/or output gains).
Budget:

- Testing unit, Google Nexus 7 Tablet $284

The testing unit is required to calibrate the app. Since the app will be specifically tailored for this device (Google Nexus 7 Tablet), a physical unit will be required to test the specific output gain and create a dB HL (decibel hearing level) threshold. Also a physical unit is necessary to determine usability and function in a real life setting. The output gain cannot be calibrated using an emulator or any other Android device, as the gain is output specific. This model was chosen due to its widespread popularity. Because the product is developed and maintained by Google, it will benefit from all future operating system updates. This is an issue that is common with many Android devices that are unable to upgrade to the latest operating system because of hardware limitations. It is required to have a testing unit to design a professional app.

Environmental: The code used will be recyclable and environmentally friendly. Uses products that are already available.

Sustainability: Highly sustainable, as the app can be updated, and will be designed for a lasting professional platform and comparatively future-proof.

Manufacturability: Easily reproducible (download distribution).

Social/Ethical: Make certain that the design created is our own, and that we are not reproducing someone’s idea.
Safety/ Health: Volume will be attenuated appropriately to avoid any chance of hearing damage.

The App will be an accurate and efficient test of auditory stimulus response. The results will be comparable to a clinical audiogram, designed to determine the threshold of hearing. The user will begin by identifying the type of headphone he/she is using, choosing from a list of headphone varieties and possibly models i.e. over-ear, ear-buds.

The frequencies will be scaled and calibrated contingent upon the type of headphone selected in the starting menu. The user will then be able to determine whether or not he/she is suffering from hearing impairment based on their test results. Some limitations of the app depend on the operation of the app. The app will work optimally in a quiet environment, using a pair of Apple ear bud headphones.