International Journal of Engineering Research and Applications *www.ijera.com*
ISSN: 2248-9622, pp. 50-55

RESEARCH ARTICLE OPEN ACCESS

"Auditory Testing and Analysis of Healthy Individuals in Matlab Using Psychoacoustic Toolbox"

Dr. S.Bhargavi
Dept. of ECE, SJCIT, Chickaballapur, India

Adwaith Prabhakaran
Dept. of ECE, SJCIT, Chickaballapur, India

Chirag R Rai
Dept. of ECE, SJCIT, Chickaballapur, India

Jashwanth R S
Dept. of ECE, SJCIT, Chickaballapur, India

Jathin K A
Dept. of ECE, SJCIT, Chickaballapur, India

Abstract— Psychophysics is one of the critical factors to evaluate the auditory testing in people. The existing system has been a success in exploring the temporal resolution with admire to auditory stimulus thereby supporting within the evaluation of the auditory psychophysics in humans which has huge acceptance in behavioral research. This assignment paintings are focused on subjects and not using a recognized auditory pathological history, both women and men of varying age groups. Absolute Threshold test (ATT) based technique can be very beneficial in physical training and rehab processes and consequently may be a completely beneficial device inside the evaluation of auditory temporal decision of males and females in diverse packages.

Keywords— Psychophysics; Temporal resolution; Stimulus; Absolute Threshold Test.

I. INTRODUCTION

Psychophysics is the medical look at of the connection between stimuli and the feeling and perceptions evoked by means of those stimuli. Auditory psychophysics is the examiner of auditory stimuli. Issues with any part of the nervous system will abate the interaction, in such instances the human beings show situations together with listening to loss, studying issues, autism, dysgraphia, dyscalculia, dyslexia, left-proper disorientation and finger agnosia. An audiometry takes a look at, assessments pre capability to hear sounds. Absolute Threshold test is a singular technique based on intensity; it's been evolved to obtain the subjective listening to perception of regular individuals.

Auditory threshold of females is better compared to males. As auditory value increases the hearing sensitivity decreases and it becomes harder for the listener to detect soft sound. As the age increases our hearing capacity decreases. The smaller adjustments in threshold observed at better frequencies are probable due to the more baseline hearing loss at higher frequencies for the older adults.

For younger age groups, the changes in thresholds are finest at higher frequencies, with less hearing loss for decreasing frequencies. However, the charge of alternate in thresholds for the lower-frequency vicinity, such as frequencies essential for hearing and information speech, will increase for older age tiers (70–89 years of age).

II. METHODOLOGY

The project is proposed to obtain the absolute threshold of healthy people based totally on Absolute Threshold test. The absolute threshold test is performed in MATLAB using psychoacoustics toolbox. In psychoacoustics toolbox the absolute threshold value of different categories such as age, sex, occupation, etc. are obtained using Maximum Likelihood Procedure and this procedure is repeated with several healthy individuals to calculate the average value of the threshold according to the audiometric test. This average value is compared with normal person's Absolute Threshold value and using that the hearing perception of that person is obtained. The MATLAB GUI pops up first and the

default value of intensity is set. The hearing response is then noted. Depending on the response of the person, the actions are taken. If the person is able to hear, the intensity of the next dB value is moved towards the pre-set threshold value. If the person is not able to hear, the intensity moves away from the pre-set threshold.

III. BLOCK DIAGRAM

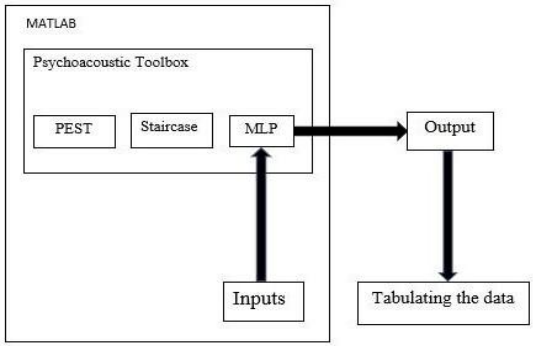

Fig.1.Block diagram

Fig. 1 indicates the block diagram for providing input to the subjects. The device comprises of a headphone which can be used to provide inputs to the subjects. Psychoacoustic toolbox is interfaced with MATLAB. Psychoacoustic consists of Parameter Estimation by sequential testing (PEST), Staircase, Maximum likelihood Procedure (MLP). In this project

Maximum likelihood Procedure (MLP) is used which is best way to get the Absolute Threshold value. When MLP test is selected window in which the values have to be entered and the specifications of the test such as the number of blocks required or how many trials have to be taken. Then press enter to start the test in which initially there is a beeping sound in the headphones, if the subject is able to hear the beep, then "1" is to be entered manually else if the subject does not hear any beep sound, then "0" is to be entered manually. MLP saves facts documents (tab- delimited, flat format, textual content documents) within the MATLAB contemporary directory. The values at which the sounds had been heard have been stated. Then, the graphical illustration of common threshold fee is plotted.

IV. SOFTWARE REQUIREMENTS

A. MATLAB

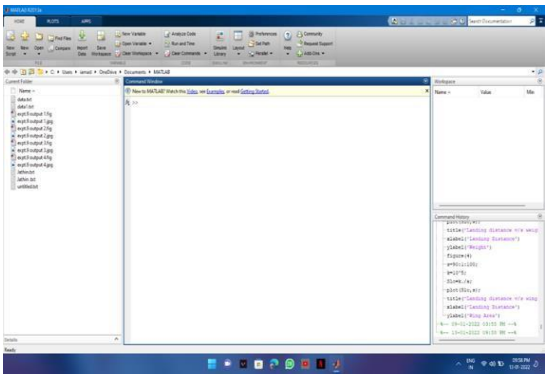

Fig.2.MATLAB

Fig.2 shows MATLAB, which is a proprietary multi- paradigm programming language and numeric computing environment evolved by using Math Works. MATLAB lets in matrix manipulation, plotting of capabilities and statistics, fulfillment of algorithms, creation of consumer user interfaces, and combining with packages written in different vernacular. As its call consists of the word Matrix, MATLAB does its all computing primarily based on mathematical matrices and arrays. MATLAB tool is used for high-productivity choice of different studies, improvement, and evaluation. MATLAB capabilities a family of software-specific solutions known as toolboxes. Very critical to most customers of MATLAB, toolboxes assist a person to analyze and observe modern techniques. There are also diverse non-obligatory "toolboxes" available from the developers of MATLAB. Very vital to maximum users of MATLAB, toolboxes allow you to study and observe specialized technology. Millions of engineers and scientist's worldwide makes use of MATLAB for variety of utility in enterprise and academia, such as deep getting to know and device getting to know, signals processing and communication, picture and video compression, control system, assessments and measurements and many others. MATLAB uses a laptop surroundings formed for incremental analysis and layout approaches uses programming languages that express both matrix and array arithmetic immediately.

B. PSYCHOACOUSTICS TOOL BOX

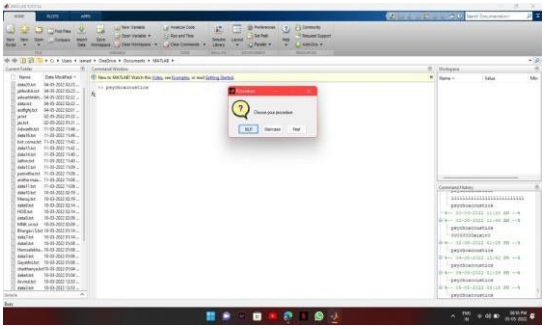

Fig.3.Psychoacoustics Tool box

Fig 3 shows the Psychoacoustics Toolbox. The tool box consists of more than twenty built-in experiments every furnished with the encouraged values. However, if preferred, these values can be changed whenever the user needed and saved for future use. In the end, PSYCHOACOUSTICS could be very friendly because it has built in default values and may be effortlessly extended for different work.

The experiments blanketed in the toolbox are (i) the most traditional Psychoacoustic analysis, permitting the person to copy set up tests or to conform them to specific values; (ii) Analysis that, to date, had been run with non-adaptive tactics only, allowing the consumer to behavior the identical tests with flexible strategies; and (iii) Completely new tests, imparting the person with instances of utilization of the tool box and to research Psychoacoustics capabilities.

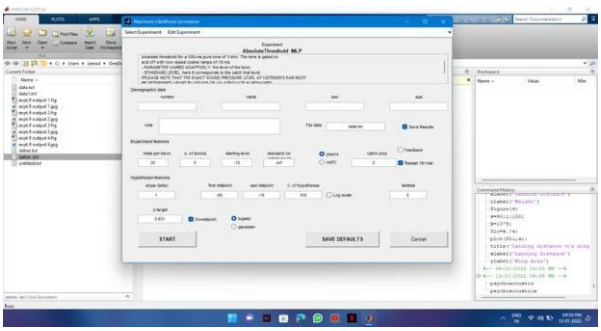

Fig.4.Maximun likelihood procedure

Fig.4 shows the Maximum Likelihood Procedure. MLP preserves two statistics files (tab-delimited, flat layout, textual content documents) in the MATLAB software. The first file is an extended statistics document which includes all experiments' activities: i.e., subject wide variety, call, age, gender, and note, block wide variety, number of blocks, status of the stimulus offered, problem's reaction, Threshold expected after every trial and envisioned fake alarm fee γ (please word this ultimate estimate is for sure/no responsibilities best). On this record the subjects' feedback is represented as "1" ("yes", or accurate) and "0" ("no", or incorrect). The title given to this record may be put by the subject through the graphical interface. The next information folder includes handiest the user's threshold and it will be stored later each difficulty. User can call this record by default. If the user does not enter the concern's name means the folder will be saved as untitled.txt.

IV. FLOW CHART

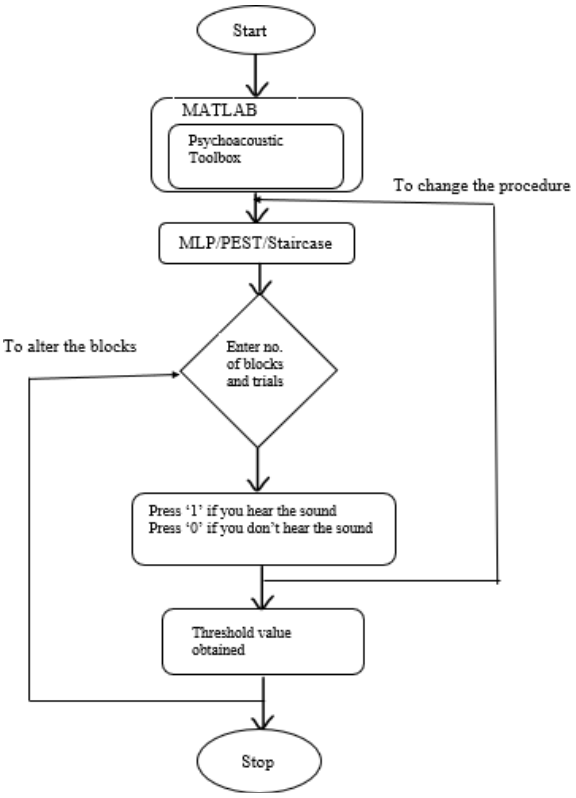

Fig.5 Flow chart of Auditory tests

Fig.5 indicates the flowchart of the proposed model. Open MATLAB and enter "psychoacoustic" in the MATLAB tool. The Psychoacoustic toolbox pops up. This tool box consists of three tests MLP, PEST and Staircase. Select one of the above tests and a window in which the values have to be entered and the specifications of the test such as the number of blocks required or how many trials have to be taken. Then press enter to start the test in which initially there is a beeping sound in the headphones, if the subject is able to hear the beep, then "1" is to be entered manually else if the subject does not hear any beep sound, then "0" is to be entered manually. MLP saves statistics folders (tab-delimited, flat layout, textual content folder) inside the MATLAB software. The first saved file is a record that carry all the experiments activities: i.e., problem range, call, intercourse, age and be aware, block value, test quantity, degree of the stimulus offered, issue's reaction, threshold estimates after

each test. The values are noted down and tabulated. The average of the values is then calculated and the average threshold value is noted. The graph is plotted according to the average values noted above. This completes the auditory testing.

V. RESULTS AND DISCUSSION

Sn.No	Name	Sex	Age	Block 1	Block 2	Average
1	Subject 1	Female	21	12.537	11.737	12.137
2	Subject 2	Female	22	16.537	14.137	15.337
3	Subject 3	Female	22	10.937	9.337	10.137
4	Subject 4	Female	22	2.137	0.537	1.337
5	Subject 5	Female	24	13.537	11.737	12.637
						10.317

The table1 Indicates the average ATTh values of females under the age group of 20 to 30 years.

Sn.No	Name	Sex	Age	Block 1	Block 2	Average
1	Subject 1	Female	32	6.937	2.937	4.937
2	Subject 2	Female	35	9.337	2.937	6.137
3	Subject 3	Female	36	12.737	14.717	13.727
4	Subject 4	Female	33	8.937	6.737	7.837
5	Subject 5	Female	39	10.964	8.107	9.5355
						8.4347

The table 2 Indicates the average ATTh values of females under the age group of 30 to 40 years.

Sn.No	Name	Sex	Age	Block 1	Block 2	Average
1	Subject 1	Female	55	9.337	5.337	7.337
2	Subject 2	Female	44	11.737	9.337	10.537
3	Subject 3	Female	47	13.737	11.364	12.5505
4	Subject 4	Female	52	18.164	16.364	17.264
5	Subject 5	Female	53	20.964	18.364	19.664
						13.4705

The table 3 Indicates the the average ATTh values of females under the age group of 40 to 60 years.

Sn.No	Name	Sex	Age	Block 1	Block 2	Average
1	Subject 1	Male	21	18.937	7.737	13.337
2	Subject 2	Male	22	26.937	18.137	22.537
3	Subject 3	Male	24	16.137	10.937	13.537
4	Subject 4	Male	22	20.737	12.737	16.737
5	Subject 5	Male	22	28.137	20.737	24.437
						18.117

The table 4 Indicates the average ATTh values of males under the age group of 20 to 30 years.

Sn.No	Name	Sex	Age	Block 1	Block 2	Average
1	Subject 1	Male	32	14.937	10.937	12.937
2	Subject 2	Male	35	17.337	10.937	14.137
3	Subject 3	Male	36	20.737	22.717	21.727
4	Subject 4	Male	33	16.937	14.737	15.837
5	Subject 5	Male	39	18.964	16.107	17.5355
						16.4347

The table 5 Indicates the average ATTh values of males under the age group of 30 to 40 years.

Sn.No	Name	Sex	Age	Block 1	Block 2	Average
1	Subject 1	Male	51	23.937	25.137	24.537
2	Subject 2	Male	47	18.364	20.964	19.664
3	Subject 3	Male	42	19.137	21.964	20.5505
4	Subject 4	Male	58	25.355	26.126	25.7405
5	Subject 5	Male	45	17.935	19.622	18.7785
						21.8541

The table 6 Indicates the average ATTh values of males under the age group of 40 to 60 years.

Age	Male	Female	
20-30	18.117	10.317	**14.217**
30-40	16.435	8.4343	**12.4346**
40-60	21.845	13.471	**17.658**
	18.799	**10.7408**	

The table 7 Indicates the average ATTh values of men and women of varying age categories.

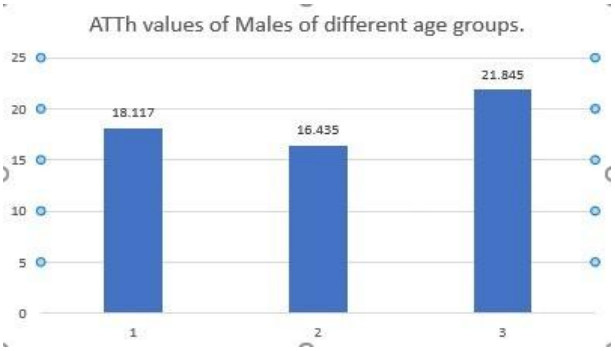

Fig.6 ATTh values of males of different age groups.

Males may have highest hearing threshold breakdown at excessive frequencies because of noise publicity of their place of business, while girls have better listening to threshold deterioration at low frequencies resulting from the atrophy of the stria vascularis. But, in later lengthy-time period, longitudinal epidemiological studies on age-related hearing loss, those gender-associated audiometric detections were scaled down. In current recent studies, the sex-associated difference of the audiometric shape in elderly is substantially decreased, in all likelihood due to the lifestyle and environmental variation among the genders within the several years.

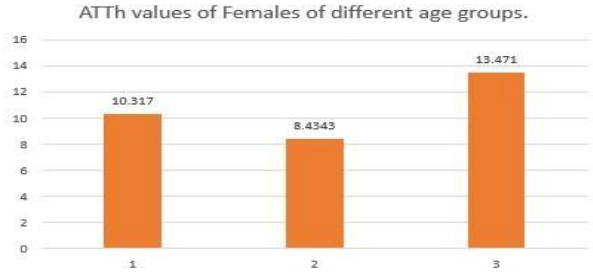

Fig.7 ATTh values of females of different age groups.

Another observation that can be made is the huge difference in the average ATTh values of age groups 30-40 and 40-60. This is mostly regarded as Presbycusis; age related hearing loss. The modifications in threshold found are in all likelihood because of the extra baseline hearing loss for the older adults. Aging is also held responsible for sensorineural hearing loss which occurs when the inner nerves and hair cells of the ear are damaged. In

the older generation ototoxicity can also cause hearing losses.

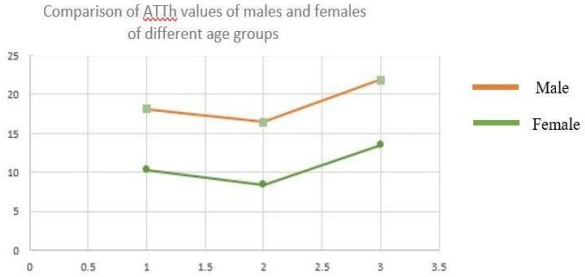

Fig.8 Comparison of ATTh values of men and women of varying age categories.

The above Fig no's 6, 7 and 8 gives a mathematical study of the ATTh acquired by conducting the tests on the subjects of different age groups. The results obtained from the paradigm can be used to analyze the differences in the lowest volume levels that each of the subjects can respond to.

It can be observed that the average ATTh value of age group 20-30 is slightly higher than that of the average of ATTh of subjects of age 30-40. This result is against the naturally known fact that younger subjects tend to have better reception to sound. This result might be able to explain that the younger generations of today show evidence of noise induced hearing loss in one or both ears. Prolonged exposure to loud sounds can cause this deterioration in hearing. Uses of ear buds can be held accountable for this as the subjects of age 20-30 tend to use it more on a regular basis. Usage of tight earbuds can hold the sound pressure in the ear canal and tend to do more damages.

VI. APPLICATIONS

1. ATT based approach is able to differentiate the patients based on their age and gender, which was not possible using the audiometry test.
2. The data obtained from auditory test can provide a better understanding about the auditory problems faced by particular generations.
3. This approach is able to make-out the difference in listening to potential between the left-ear and the right- ear.
4. Better than audiometry tests as it can assess the hearing insight in Homo sapiens with respect to their profession and also for training purpose.

VII.ADVANTAGES

1. ATT primarily based approach could be very beneficial in physical activities education and for this reason may be a completely helpful in the analysis of auditory temporal resolution of people in numerous implementations.
2. This approach could be advantageous in rehabilitation centers, and is helpful to identify the issue in the victim at a much faster rate.
3. The dataset formed by these tests can be used to analyze the variations in the auditory resolution between different age groups.

FUTURE SCOPE

The data accumulated from this project can be used to analyze the hearing gap between 10+ generations and Artificial Intelligence and Machine Learning can be used to predict the future thresholds so that the necessary steps can be taken in order to reverse the predicted effect.

ACKNOWLEDGMENT

The authors wish to thank Dr. S Bhargavi and Dr. H S Sanjay for providing a regular assist for the duration of different phases of project work. Also credits to staffs and students of S.J.C. Institute of Technology, Chikkaballapur for helping with data collection.

REFERENCES

[1]. H S Sanjay, S Bhargavi and S Madhuri, "Auditory psychophysical analysis of healthy individuals based on audiometry and absolute threshold test", International Research Journal of Engineering and Technology, Vol. 17, pp. 99-106, March 2018.
[2]. Mark Bastianelli, et.al., "Adult validation of a self-administered tablet audiometer", Journal of Otolaryngology, pp. 48-59, November 2019,.
[3]. H S Sanjay, S Bhargavi and P A Dinesh, "Auditory Temporal Resolution based Psychophysical Evaluation of Healthy Individuals Exposed to Desired and Undesired Conditioning", Biomedical and Pharmocol Journal, Vol. 10, No. 3, pp. 1449-1461, August 2018.
[4]. Rakhi Kumari, Priyanko Chakraborty, R K Jain and Dhananjay Kumar, "Auditory assessment of children with severe hearing loss using behavioural observation audiometry and brainstorm evoked response audiometry", International Journal of Research in Medical Sciences, Vol. 4, No. 7, pp. 2870-2873, February 2017.
[5]. C. Henderstierna and Ulf Rosenhall, "Age-related hearing decline in individuals with and without occupational noise exposure, Noise & Health", Vol. 18, No. 80, pp. 21-25, January-February 2016.
[6]. Melissa Saenz and R M Dave Langers, "Tonotopic mapping of human auditory cortex, Hearing research", Vol 307, pp. 42-52, 2016.

[7]. M Y Boboshko, et.al., "The speech audiometry test with the verbal tasks and motor responses", Vestn Otorinolaringol, Vol. 80, No. 4, pp. 47-51, 2015.
[8]. Alessandro Soranzo and Massimo Grassi, "Psychoacoustics: a comprehensive MATLAB toolbox for auditory testing", Frontiers in Psychology, Vol. 5, Article 712, pp. 1-12, July 2014.
[9]. C Greta Stamper, et.al., Auditory function in normal-hearing and noise- exposed human ears, Ear and hearing, Vol. 36, No. 2, pp. 72-84, March- April 2015.
[10]. Alice Cazzolato, et.al., "Auditory abilities of young adults, middle-age adults and old adults", Giornale italiano di Psicologia, Vol 42, No. 1-2, pp. 249-262, March 2015. accessed on 19 April 2022.
[11]. https://dpg.unipd.it/en/mlp/mlp-toolbox accessed on 21 March 2022.
[12]. http://surl.li/bhyqu accessed on 10 January 2022.
[13]. https://www.mathworks.com/products/matlab.html accessed on 11 October 2021.
[14]. https://dpg.unipd.it/en/mlp/psychoacoustics accessed on 22 October 2021.