D3.2 Application Documentation (Public Report)

29/09/2017

3D-games for TUNing and lEarnINg about hearing aids

Version FINAL

2

Preparation date 29 September 2017

Deliverable D3.2

Work Package 3

Authors: Ragnar Hrafnkelsson & Yuli Levtov, Reactify

Approved by Coordinator on: 29 September 2017

Approved by Quality Manager on: 28 September 2017

Dissemination level: Public

Table of Contents

List of Figures

Abbreviations and Acronyms

3DTI	3D Tune-In
EU	European Union
SME	Small and Medium-sized Enterprise
UMA	University of Malaga
HLs	Hearing Loss Simulator
HAs	Hearing Aid Simulator
WP	Work Package
XTeam	XTeam Software Solution

Executive Summary

This is the public deliverable D3.2: Application documentation of the EU H2020 project 3D Tune-In (3DTI - 644051). This work was carried out as part of WP3 Development of the Applications. This deliverable consists of publicly accessible documentation for the five applications produced by the SME partners to showcase the 3D-Tune-In Toolkit: Play & Tune, Dartanan, AudGam PRO, Darius Adventure and Musiclarity. Each application segment contains a short general description along with an overview of audiological features and integration with the 3DTI Toolkit.

Section 1: Introduction

This deliverable describes the applications developed in WP3. The specific objectives of the applications are to road-test features, usage and integration methods of the 3DTI Toolkit (produced in WP2) and thus create a suite of applications that potentially demonstrate its efficacy, flexibility and relevance to the market and to provide constructive feedback regarding the features of the 3DTI Toolkit into its continued production and maintenance.

The 3D Tune-In Toolkit has been developed by the University of Malaga and Imperial College London. It is a standard C++ library for audio spatialisation and simulation of hearing loss and hearing aids. The Toolkit includes a real-time 3D audio renderer providing a high level of realism and immersiveness within 3D audio simulations (both speaker and headphones-based). It also includes a non-linear simulator of hearing loss and a simulator of hearing aid devices. The 3D Tune-In Toolkit is released as open source for non-commercial use.

Section 2 contains descriptions of each application and documentation on features using the 3DTI Toolkit.

Section 2: Applications

2.1: Play & Tune (Vianet)
Windows/Mac - http://www.3d-tune-in.eu/applications/elderly-hearing-aid

Play & Tune is an application developed by Vianet that includes a number of engaging games such as "At the Restaurant", "Magic Garden", "Noisy street". It is specifically designed for mobile phones and tablets; PC and Mac versions are available too. Each game simulates a series of virtual scenarios with realistic sounds where players face different challenges and learn how to calibrate the different functions of their hearing aids: adjusting volume in the right ear - left ear, tone control, compression, sound quality etc. Play & Tune is part of HearinGame Studio, a family of interlinked applications jointly distributed by XTeam, GN Hearing, and Vianet.

2.1.1 Integration with the 3D Tune-In Toolkit
Play & Tune is developed in Unity3D and uses the Unity wrapper of the 3DTI Toolkit, developed by UMA, on all available platforms. Two main toolkit modules are used: binaural spatialisation and the hearing aid simulator.

2.1.2 Audiological features
The most important feature of Play & Tune is a simplified control dashboard that the players can use in order to fine tune their virtual hearing aids; through the function 'Tune Virtual Hearing Aid', end-users can change some acoustic parameters clicking on the menu that they see on the left side of the screen. Current parameters are Left-Right ear Volume, Directivity, Tone control, Compression, Sound quality. On the bottom part of the screen, they have the possibility of playing back various audio simulations such as speech of a person, cafe, bus stop, street indoor, street traffic, park. See Fig *1*

In Sound Quality, the user can decide if he wants a better quality sound (Quality option) or a Performance sound, indicated for devices with lower performances. See *Fig 2*

In the section "Compression", the user can choose a different kind of compression: a high value of compression means that quiet sounds are amplified more than loud sounds. A low value of compression means that all sounds are amplified in the same way, independently whether they are quiet or loud. See Fig *3*

In the section "Directivity", the user can move the sliders to change the directivity of the sound; this controls how the virtual hearing aid amplifies sounds coming from different directions. Moving the slider towards the directional setting will result in the hearing aid amplifying mainly sounds coming from the front and less from the sides and behind. See Fig *4*
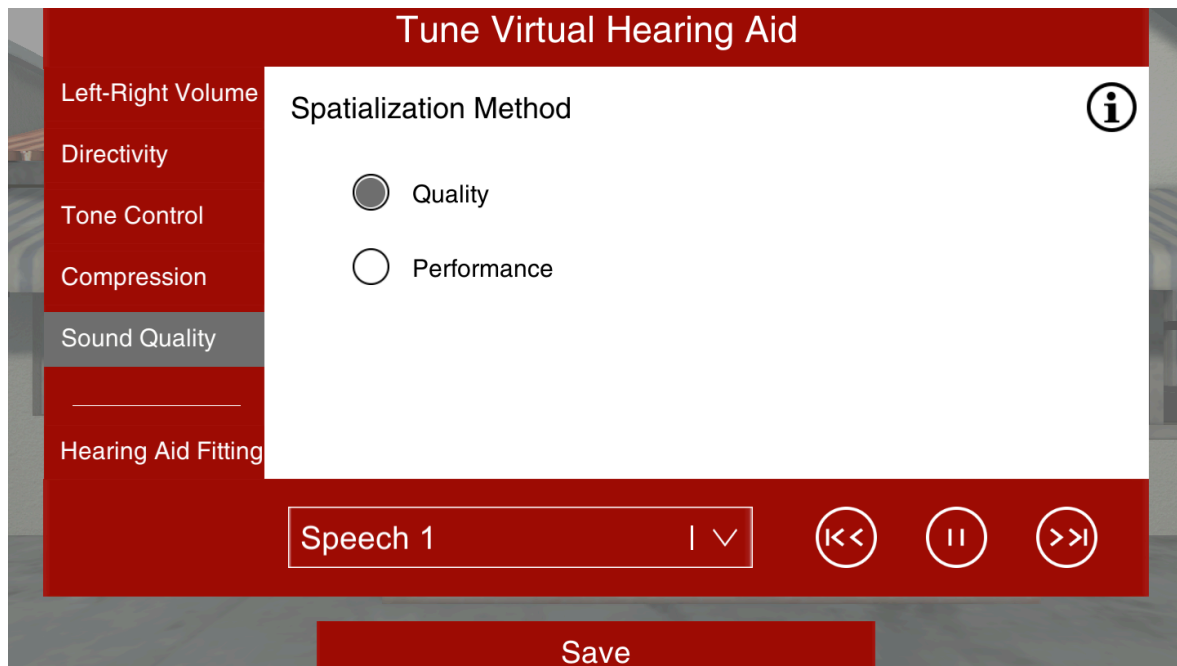
2.1.3 Screenshots

Fig 1: Play & Tune Virtual Hearing Aid dashboard
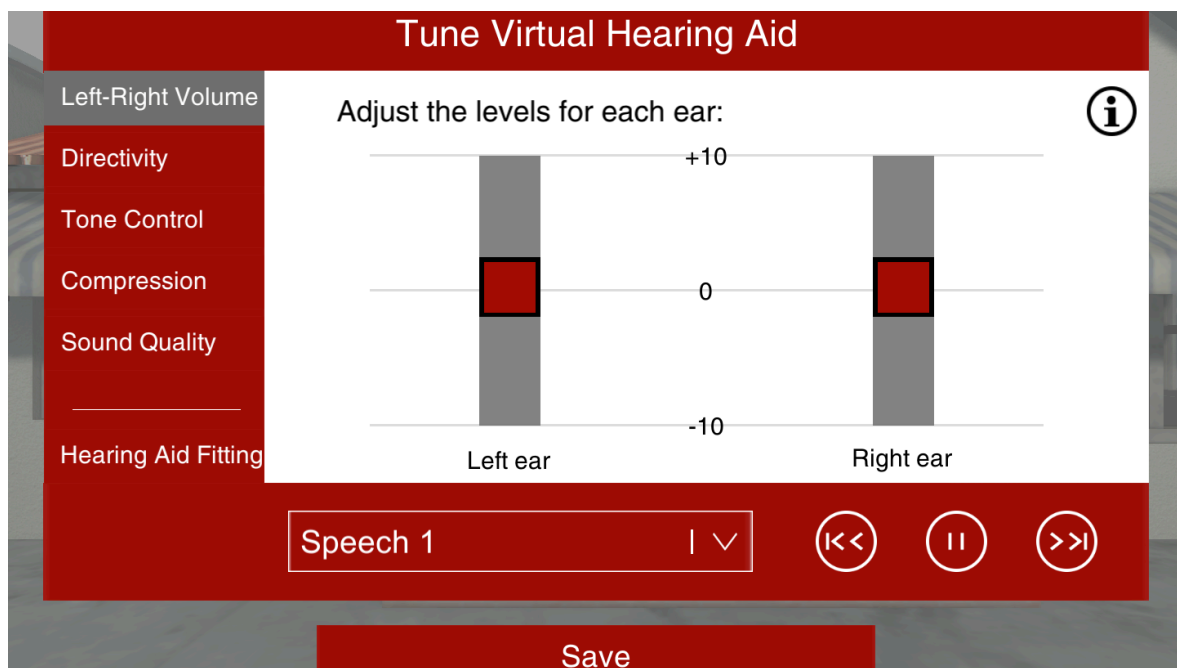

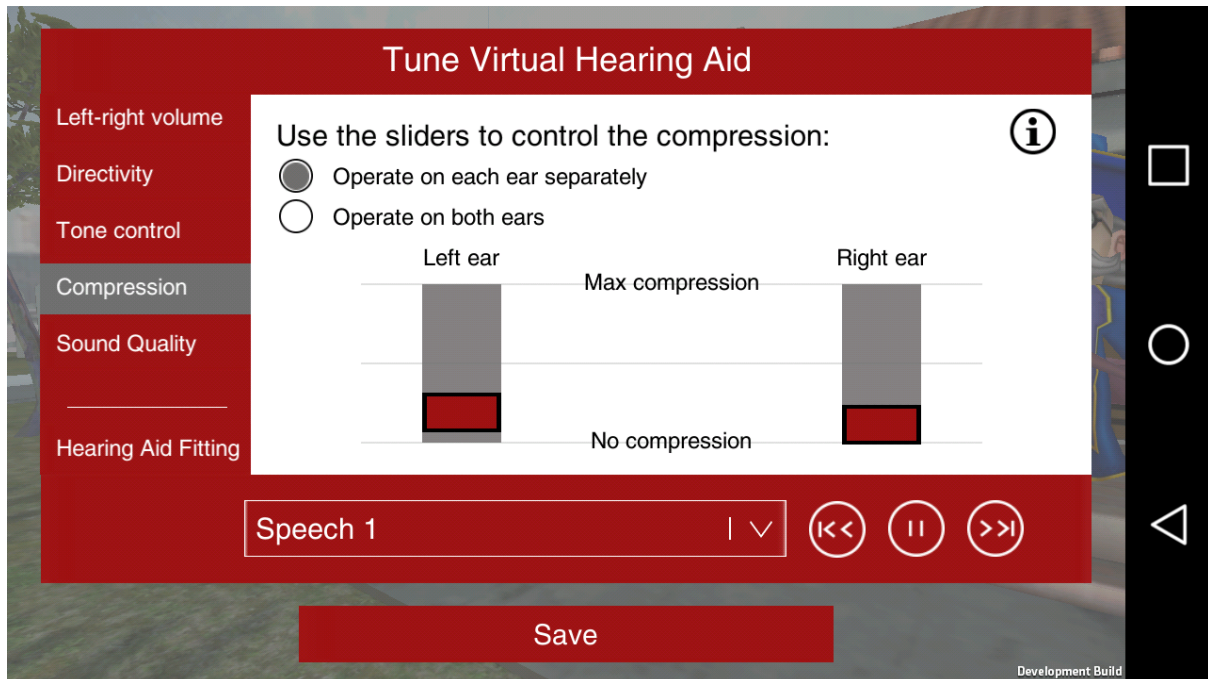*Fig 2: Play & Tune Sound Quality selector*

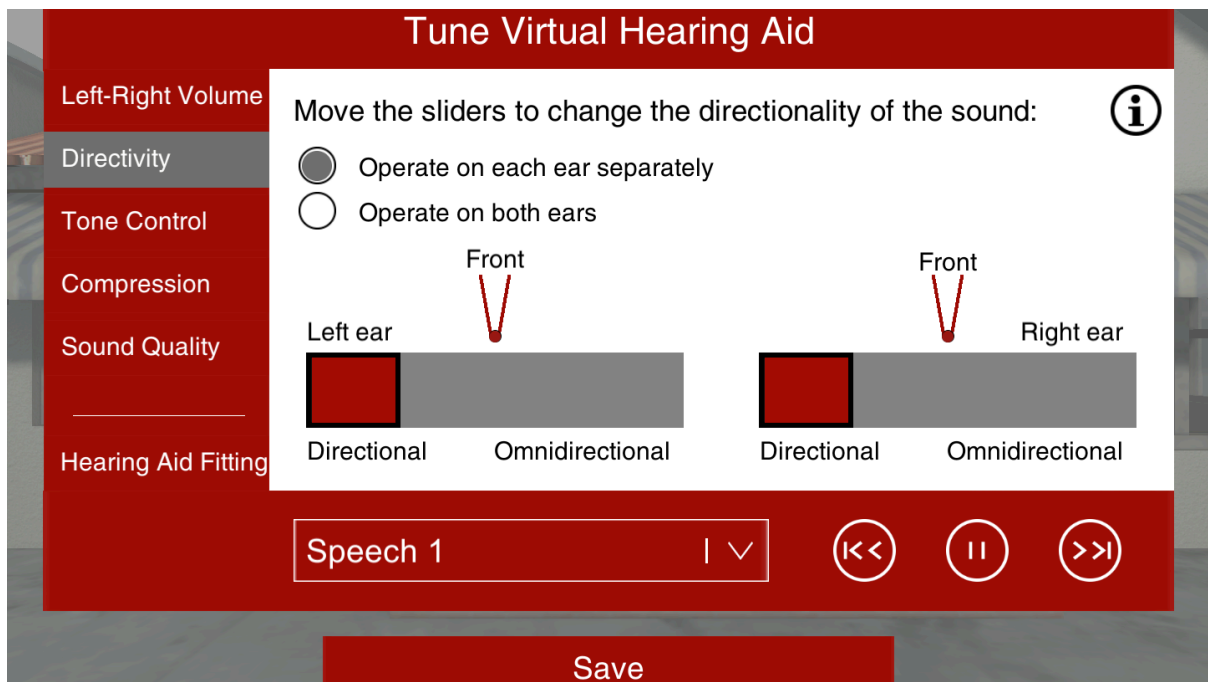*Fig 3: Compression feature of internal hearing aid tuner*

Fig 4: The Directivity control sets how the virtual hearing aid amplifies sounds coming from different directions

2.2: Dartanan (XTeam)

iOS/Android/Win/Mac - http://www.3d-tune-in.eu/applications/hearing-aid-children-gamification

Dartanan is a classic platform game, following the style of Nintendo's Super Mario. The player needs to jump over platforms, kill enemies, avoid traps, and collect coins. Dartanan uses simple gamification techniques to train players on how to calibrate the different settings of their HA and use this learning to progress through the different levels. This structure is designed to develop a leisure game that also contains serious games: children can play the main game with their friends and parents, and the mini-games can be adapted to different target devices for training and learning purposes.

2.2.1 Integration with the 3D Tune-In Toolkit

Dartanan is developed in Unity3D and uses the Unity wrapper of the 3D Tune-In Toolkit, developed by UMA, on all available platforms. The HAs (Hearing aid simulator) of the toolkit is the primary Toolkit module featured in the game.

2.2.2 Audiological features

Dartanan teaches the player how to use hearing aid functions (volume, tone control, directivity, noise reduction) through a learning path. See *Fig 5*

Drawing on a suite of minigames, Dartanan collects data to diagnose hearing problems or incorrect hearing aids setting/calibration and sends results to audiologists.

Dartanan also offers direct control of various hearing aid simulation settings such as independent L/R volume setting, directivity, tone control and compression. See *Fig 6*

2.2.3 Screenshots

Fig 5: A game landscape in Dartanan

Fig 6: Dartanan virtual hearing aid controls

2.3: AudGam Pro (GN Hearing)

Windows - http://www.3d-tune-in.eu/hearing-aids-calibration-game

AudGam Pro is aimed at audiologists and hearing aid users from all age groups. Its main goals are to assist audiologists in providing a flexible environment to simulate multiple every day situations for their patients from the comfort of their clinic, and to help hearing impaired people learn about the functions of their hearing aids. The application helps the audiologists to assess hearing loss, fit the HAs and demonstrate the potential of hearing aids.

2.3.1 Integration with the 3D Tune-In Toolkit

AudGam Pro is made using the Unity wrapper of the 3D Tune-In Toolkit, in particular the HAs (Hearing Aid Simulator) module.

2.3.2 Audiological features

AudGam Pro can be helpful to compare the hearing ability of the patient in the different situations using different models of HAs in an innovative way, in order to define a more personalised profile, simulating different environments to inform audiologists and patients of the best choice of HA and its fitting.

AudGam Pro offers a councelling module which allows the audiologist to show to the patient his/her sound discrimination skills in an simplified way. See *Fig 7*

A Data Analyser module lets the audiologist to create a polar pattern of patients' hearing skills and show them a hearing profile in an innovative way. The app will show polar patterns of the patient (left and right ear or binaural) and allows comparison of up to four profiles. See Fig *8*
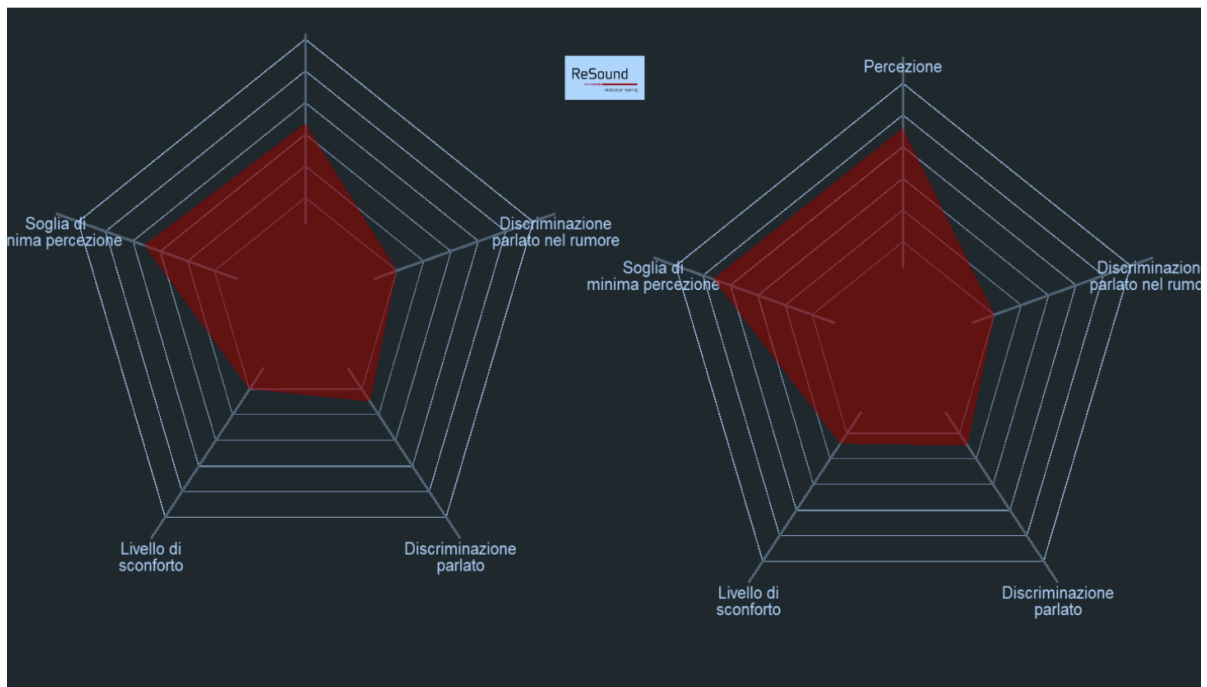
2.3.3 Screenshots

Fig 7: AudGam Pro counseling module

Fig 8: Data Analyser module

2.4: Darius Adventure (Nerlaska)

Windows/Android/iOS - http://www.3d-tune-in.eu/applications/hearing-educational-games

Darius Adventure is a graphic adventure game aimed at children without hearing loss. The main objective is to educate non-hearing impaired people about hearing impairment through simulated hearing loss. The main target group is for children who may have relatives and friends suffering from a hearing disability. The game's protagonist, Darius, is an angel with sensorineural hearing loss, and has fallen from heaven and lost his wings. The player must guide Darius through several scenarios to solve challenges and complete levels to recover feathers and rebuild his wings so that he can return to heaven. The act of putting the player into the position of a character with hearing loss is intended to provide educate and create empathy that the player can take into their real-world relationships.

2.4.1 Integration with the 3D Tune-In Toolkit

Darius Adventure uses the DX9 wrapper for Windows, and custom wrappers for iOS and Android. Only the DX9 is publicly available, the others are owned by Nerlaska and are fully integrated into the NLK Engine used by Nerlaska for creating multi-platform games.

Darius adventure uses the HLS (Hearing loss simulator) and HAs (hearing aid simulator) features of the 3D Tune-In Toolkit.

2.4.2 Audiological features

Darius Adventure offers three levels of HLS: moderate, mid and severe as well as simulation of three different hearing aid devices: 8 bit, 10bit, 12bit quantisation with mono/stereo and directionality too. It contains various background and environmental noises to simulate real world scenarios for training and education. Finally, the game features gamified coping strategies for people with hearing loss through visual directions.

2.4.3 Screenshots

Fig 9: Darius Adventure gameplay

Fig 10: Darius Adventure gameplay

2.5: Musiclarity (Reactify)

Web (Desktop) - http://www.3d-tune-in.eu/applications/hearing-aid-musical-listening

Musiclarity is an interactive music rehabilitation application dedicated to improving hearing aid users' experience of listening to music.

The application allows users to change the volume of the individual instruments within a piece of music so as to sound optimal for their particular level of hearing loss. The website also guides users on how to change the settings of their hearing aids to further refine the quality of sound. This improved understanding of their hearing aid provides a tangible benefit in everyday life.

Lyrics and visual representations of different instruments are displayed alongside the music, and users can even 'move' the instruments to different positions around their head to hear the various instruments with more clarity.

An individual can use Musiclarity at home or with an audiologist in order to calibrate their hearing aids and create a setting that allows them to enjoy music more in their daily lives.

2.5.1 Integration with the 3D Tune-In Toolkit

Musiclarity is a web application and uses the 3D Tune-In JavaScript wrapper, developed by Reactify. The JavaScript wrapper contains Binaural spatialisation, HAs and HLs modules of which Musiclarity uses the first two.

2.5.2 Audiological features

The main feature of Musiclarity is the ability to change the volumes of the individual instruments within a piece of music. This is done via a simple layout of volume bars, each reprensting a different instrument in the track. Each volume bar also has a 'Mute' and 'Isolate' button, to quickly either remove or isolate that instrument in the track.

The 3DTI Toolkit binaural spatialiser module allows for positioning the individual instruments around the listener's head. A simple top-down view of where each instrument is positioned is provided, for the user to be able to change and experiment with this feature. See *Fig 2.5.3.1*

A fully featured virtual hearing aid is also provided so that users can remove their hearing aids and listen to the website using regular headphones. Users can input their level of hearing loss via presets such as 'Mild', 'Moderate', and 'Severe' hearing loss, a special code provided by the 3DTI Hearing Loss Test app, or a full audiogram as provided by an audiologist. Additional settings for tone control, compression, and level boosts in each ear are also provided. See *Fig 2.5.3.2*
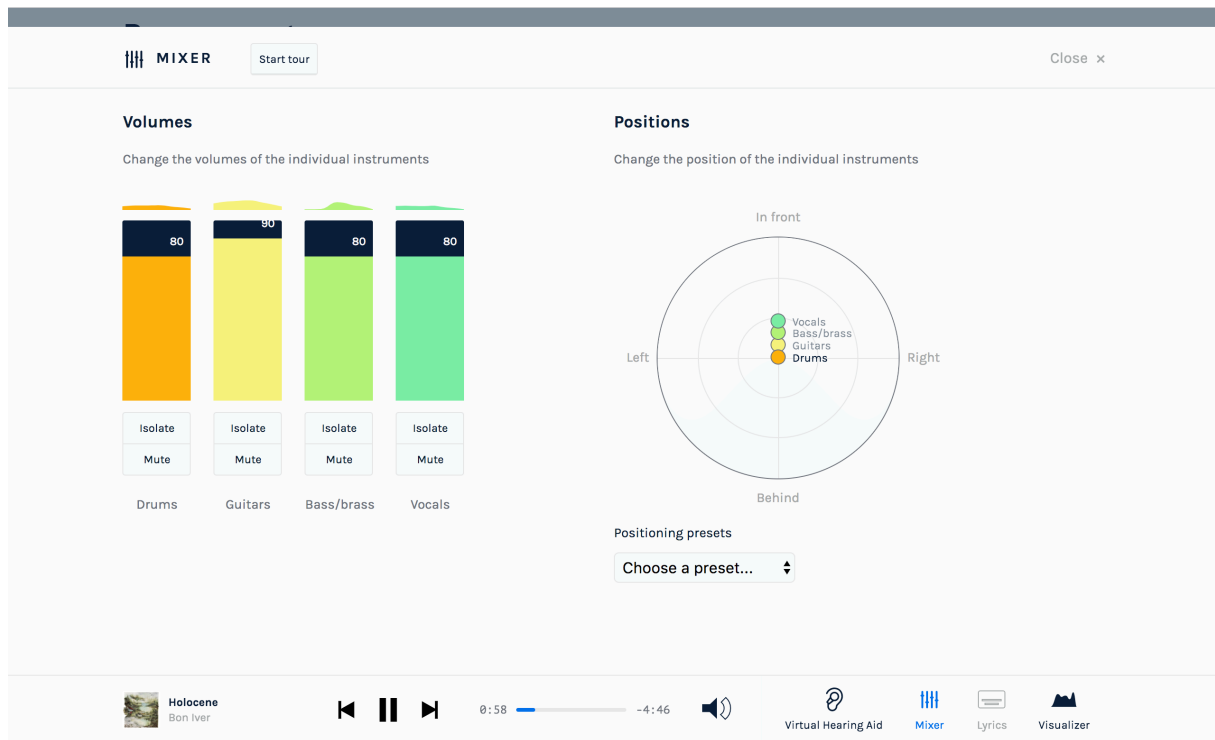
2.5.3 Screenshots

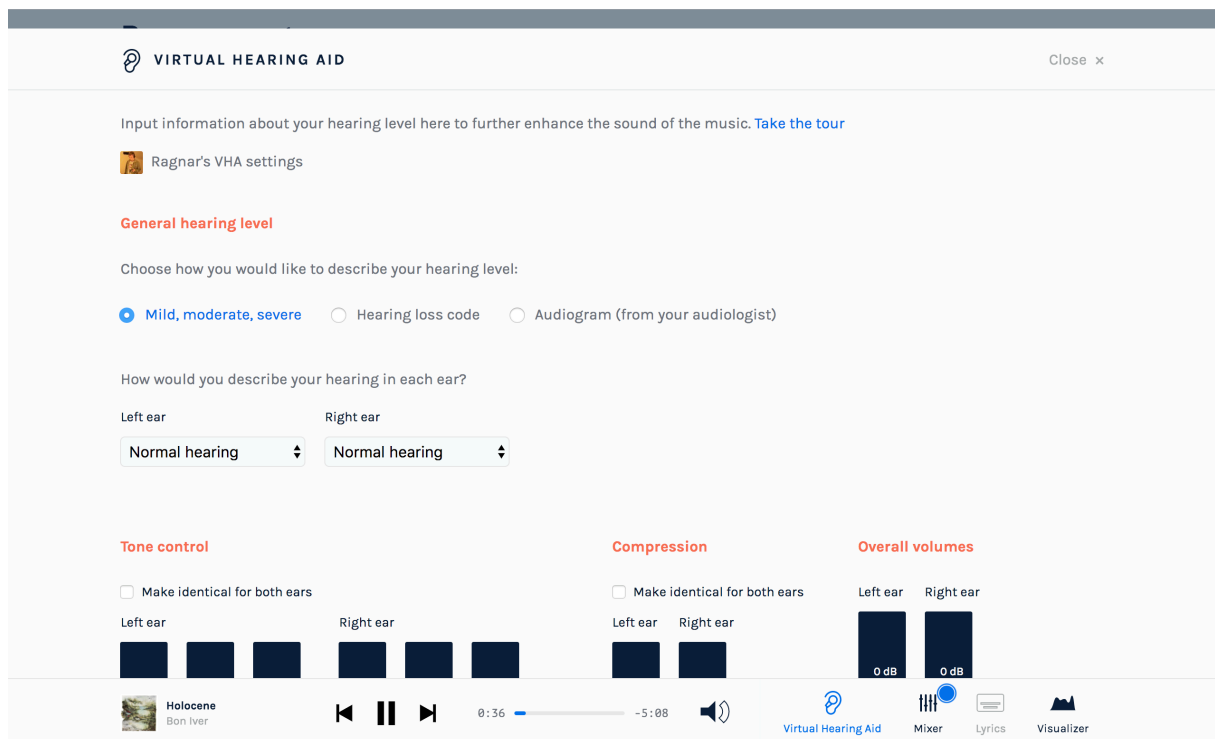*Fig 11: Musiclarity mixer. Spatialisation controls are to the right*

Fig 12: Musiclarity Virtual hearing aid

Section 3: Conclusion

The applications are expected to be released by the development teams early next year.