Hack4ears - Hackathon for the Hearable of the Future

The Hackathon "hack4ears" took place on the 8th and 9th of November in Motionlab Berlin, organized by Fraunhofer IDMT. The goal of the hack4ears was to come up with new ideas for the future of Hearables (such as headphones or hearing aids).

The program consisted of impulse lectures on new Hearable trends, workshops and spontaneously organized working groups. The result of a working group was awarded.

hack4ears is part of the research of the citizen science project "Hear How You Like To Hear (HHYL2H)"[1] at the Fraunhofer IDMT, led by the computer scientist Peggy Sylopp. Citizens are exploring the basics for the Hearable of the Future in this project. The focus is on subjective listening, needs and wishes of users with and without hearing impairments.

hack4ears was the first hackathon on this scale in the scientific context of hearing, speech and audio technology. 70 participants and speakers from Germany and Europe contributed their expertise in the areas of sound / audio, design, user, science and IT, hacking and make.

On the first day of the hackathon, nine keynote lectures provided a compact overview of current Hearable trends. Presented were research related to the "Hear How You Like To Hear" project, but also product trends from the economy as well as experience from the maker sector.

The presentations covered user-oriented design, individualized technical and health solutions as well as real-time adjustments to the sound and amplification of Hearables.

The project manager Peggy Sylopp opened a first insight into the research results of "Hear How You Like To Hear" (HHYL2H):

• 550 submissions of an online questionnaire suggest needs and desires for the future Hearable.

• Citizens participate in field trials, the "Soundwalks". They set the sound of the open source test device "liketohear box" with an app. The data of the settings and the acoustical environment was logged.

Participating speakers were: Sarah Mellin (Teufel Audio), Reiner Schaefer (Starkey Laboratories), Emilie Mikolajczyk (HU Berlin), Miriam Loos (Coburg University), Philip Simon (Maker), Tom Bieling (UdK Berlin), Paul Maanen (Hörtech gGmbH), Tobias Bruns (Fraunhofer IDMT), Jörn Malich (Pragmalab), Peggy Sylopp (Fraunhofer IDMT).

On the second day of the hackathon, hands-on workshops were introduced to the open-source software of the "liketohear box". Self-organized working groups deepened in the technical examination of software and hardware of the "liketohear box". There was an intensive exchange between the participants from the various areas.

Finally, a working group was awarded (among others with Jörn Malich, Ridhin Sharma, Stephan Geist, Jordy Williams). In their "liketohear-ai" prototype, an artificial intelligence analyses the logged data of the "Soundwalks". Thus, "liketohear-ai" detects the characteristic of the individual user behavior and applies it to similar listening situations.

The hack4ears summarized that the Hearable of the future should provide individual solutions that integrate the subjective hearing perception of each user. During Hack4ears, it became clear that there is a high need for cross-functional exchange and solutions for individual hearing.
Berlin, 18.11.2019,
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[1] https://www.idmt.fraunhofer.de/de/institute/projects-products/projects/liketohear.html

APPENDIX hack4ears

Project information on "Hear How You Like To Hear"

The focus of HHYL2H research is the self-adaptation of hearing enhancement algorithms in acoustic everyday situations[2].

Citizens are invited to complete an online questionnaire or to participate in fieldwork[3].

Technik-Affine are enabled to build their own open-source solution, the "liketohear-box"[4].

Keynote speeches

The opening lecture was given by **Emilie Mikolajczyk**, who is writing a bachelor thesis on therapeutic measures for the subjective treatment of hyperacusis (hypersensitivity in the perception) of hearing at **the HU Berlin, musicology**. Inspired by a notion of HHYL2H in the cyborg context, she came up with the idea of self-directed listening. Mikolajczyk proposed to make influence in the stimulus-response chain by other individual evaluations and to enable the individual control of devices.

Inspired by hack4ears 2018, **Miriam Loos** developed the "LUUI", a device for improving hearing and understanding for people with and without impaired hearing, as part of their bachelor thesis of Integrated Production Design, **Coburg**. The LUUI aimed at the independence of the users and intuitive operation, and ergonomics and wearing comfort of the device.

Hearing aid holder and **maker Philipp Simon** got help from an audiologist and reported on his experience in self-adjusting hearing aids. He stimulates the design solution by incorporating the hi-fi headphones and medical technology and acoustics industries on the market.

The invited **designer Dr. Tom** Bieling **(HAW Hamburg)** presented an inclusive design beyond normal concepts, for example, a sensory glove for the blind translating speech into touch signs.

More current Hearable trends were presented by **Sarah Mellin (User Research Teufel Lautsprecher)**. She accompanied the hackathon for two days and gave the participants the opportunity to talk and test various products. She pointed out that topics such as hearing adjustment, fashion accessory, sustainability, active noise canceling, transparent hearing and wearables have a significant influence on the market.

Introduced by **Starkey Laboratories** Product Manager **Reiner Schäfer**, the "Livio AI" Hearing Aid integrates sensors with artificial intelligence. Thus, the hearing aid with its optimal location in the ear serves as fitness tracker and for health care.

Paul Maanen (developer Hörtech gGmbH) was involved in the development of the field research device of "Hear How You Like To Hear", the "liketohear-box". And concluded an overview of the integrated openMHA (Open Master Hearing Aid). OpenMHA is an open-source software platform for real-time audio signal processing. It forms the basis for the real-time adaptation of hearing amplification algorithms in field research of the Citizen Science project HHYL2H.

The "liketohear-box" with the sound control via app was presented by the developer **Tobias Bruns (Fraunhofer IDMT)**. In the current field trials, the so-called "soundwalks", the app enables a situational adhoc setting of

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[2] https://www.terminland.de/like2hear/
[3] https://ww3.efs-survey.com/uc/HHYLTH/
[4] https://github.com/liketohear/liketohear/wiki

volume and frequency of the sound. This relatively simple functionality already represents a significant expansion over conventional hearing aids.

The project leader **Peggy Sylopp (Fraunhofer IDMT)** launched a first public insight into the preliminary trends in the research results from the Citizen Science project "Hear How You Like To Hear".

The HHYL2H online survey on the user experiences and needs for a Hearable reached 550 submissions so far. Most participants (more than half) have been affected by hearing impairment (70% with hearing support) between the age of 40 and 60. The focus of people's expectations is of noise suppression, speech intelligibility and sound quality. Half of the hearing aid users lie in the category of very satisfied to satisfied about the device. 48% of them are highly appreciated wearing hearing aids as a fashionable accessory.

Citizens act as researchers and participate in the field trial, the "soundwalks", since June 2019 with the scientific support of the project manager Sylopp. In the process, fellow researchers adjust the sound of the liketohear box during a walk in various listening situations. The data of the users' settings as well as an audio analysis (volume, frequency) were saved during the experiments.

An initial evaluation of the "soundwalk" data was made in the run-up to hack4ears with Jörn Malich (data science consultant Pragmalab). The data sets with plenty of noise reveal a trend that does not show a correlation between volume and level of amplification. However, every single user behavior show characteristics of preferred settings in specific sound environments.

This led to the development of the awarded "liketohear-ai" prototype, predicting user behavior by the means of ai. (Open source code on github: https://github.com/jarCrack/liketohear-ai-pt)

Speakers hack4ears 2019, left to right: Paul Maanen (Hörtech gGmbH, Tobias Bruns (Fraunhofer IDMT), Reiner Schäfer (Starkey Laboratories), Peggy Sylopp (Fraunhofer IDMT), Jörn Malich (Pragmalab), Philip Simon (Maker), Miriam Loos (Hochschule Coburg), Emilie Mikolajczyk (HU Berlin), Sarah Mellin (Teufel Loudspeaker)

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