







User Interview with Ghena

 Meeting Tags	User Interviews
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▼ Script

Research Questions

- Is the presented prototype easy to understand of what you can do to control our device?
- Does the terminology make sense?
- Is everything that we provide sufficient enough to record experiments with it?
- Which style should the application follow? (after presenting mood boards and colour schemes)

Interview Script

Introduction

- Doing a user interview, helps us to find out what and how we want to design things early in the creation of a new product
- We ask questions, not directly about you or to test you, but rather to gain insights for our design process
- If you don't know how to answer a question let us know, we're here to help you guide through the process, if you don't want to answer a question that's also fine, just let us know

Warm Up

- Tell us about yourself

- What do you do as your job or hobby?
 - Go into more detail to ask about the context and connection to IDUN
 - Why doing research, what fascinated them?
- What is the greatest pain at your current job/hobby? OR with what the person has mentioned in context and connection to IDUN?
 - Go more into detail and find out the WHY
- What are you currently researching if they're allowed to talk about it?
- Have you heard of brain-machine interfaces – what is a brain-machine interface?
 - Can you describe what a brain-machine interface is and how it works?
 - Have you ever worked with or thought of working with a brain-machine interface?
 - Do you have a research use case in research for a brain-machine interface?
- Have you worked with EEG before?
 - If yes, which systems from which brands?
 - What was the best EEG system you worked with and why?
 - What was the worst EEG system you worked with and why?
- Do you know the benefits of a mobile EEG system?
- What do you think is a benefit of an in-ear EEG system that is fully mobile?

Context

At IDUN, we are building an EEG system that can read your brain's signals in real time. We are not the first to do this, others have been doing it for many decades. The difference between our product and others on the market is the form factor. Our EEG device is the size and shape of a normal in-ear headphone such as Apple AirPods. Compared to e.g. a state of the art system in 2022 our device has similar signal qualities and impedance values in a form-factor which has the potential to be mainstream and the setup speed that is not comparable to any other EEG systems as of today (show some charts).

Our goal is not to develop the headphones themselves (building the brand, marketing, packaging design, etc.), but to integrate our technology (hardware as well as software) into existing headphones. And why? Because we want to be able to incorporate a fully mobile, unobtrusive and therefore mainstream-ready EEG sensor in a form factor that allows hours of measurements during everyday activities. No laboratory environment or special setup is required. Developers and researchers should then be able to interact with the brain data, for example in the form of classified outputs via an API.

- **To give you some examples of what's possible and will soon be possible in the near future:**
 - The users general focus in a range from 1–10
 - The users tiredness in a range from 1–10
 - How long, well and in which stages the user slept
 - Where the user is looking at (top right, bottom left, centre up, centre down etc.)
 - If the user is squeezing their eyes together or not or blinking and how long is blinking
 - If the user is hearing sounds in certain frequencies or what for profiles the user is able to hear
 - If the user is eating something, talking or chewing something hard or soft
 - If the user is hungry, tired, asleep, bored etc.
 - Raw data or filtered data that removes artefacts automatically already in real-time
- More things will be possible soon. Before we continue we want to hear how you feel when you hear what's possible with our device?
- Do you have any concerns about our device and application?
- We will give you two examples of what is possible to build with our device:
 - A music app that recommends music based on your mood: if you're tired it will show you two auto-generated playlists; one that makes you more awake and one that helps you fall asleep. Same with being focus, bored etc. You can replace the music playlist with basically any recommendation engine you could think of. (show example slides)

- Another more complex idea: A user is wearing a AR/VR device and you track where the user is looking at in the 3D world and based on the focal point of the users attention you increase the volume of the source and decrease surrounding sounds (also known as the cocktail party effect). (show example slides)
- What are your thoughts when you heard these two ideas?
 - Ask more questions so that the user elaborates
- Next to using our app for creating applications it should also enable researchers to setup and record experiments, possibly experiments that need to be recorded outside of the lab. here is where your experience comes into play.
- How do you proceed when you create your own experiment?
 - Here is an example experiment: Resting state experiment: person looks at a cross and does nothing for one minute, to find out if you can identify some brain health related diseases or just to measure activity in different brain regions under resting conditions. OR oddball paradigm – How would you proceed to create such an experiment?
 - What tools (hardware and software) are you using?
 - Why are you using these tools?
 - What software are you using? Why are you using this software?
 - What are pain points of these tools etc?
- What are you doing after you recorded the data set of one experiment/one participant? Let us walk through it.
 - How are you ensuring the data quality of the recorded data?
 - How are you visualising the data? MATLAB, Excel, some other tool?
 - How are you processing (pre-, post-) the recorded data?
 - What are pain points in that process?
 - Why are you using these tools?
 - What tools are amazing to help you in that regard?
 - Where are you creating your own tool?

- Where did you learn these tools, softwares etc?
- Where are you storing that data?
 - How do you ensure user privacy and data protection for the recorded data?
 - How do you collect the consent for the recorded data from the participants?

Competitors/Examples

- Can you describe the best app for an EEG system that you've used before?
 - Can you describe why this example is amazing and what they're making differently?
- Can you describe the worst app for an EEG system that you've used before?
 - Can you describe why this example is bad and what they're making badly?
- What is the most complex EEG system or lab recording system that you've ever used?
 - Let the user elaborate
- Did you ever create code snippets on your own for experiments in a lab?
 - Let the user elaborate
 - **dig more into them**
 - how did you learn these things? course, bootcamp etc?

Prototype

We have designed a prototype of this web app to help people that want to use our device without the need to code/program. our aim is an easy-to-understand graphical user interface that helps people to understand how the device works, control the device and to record data/experiments. We want you to let it go through. We don't want you to break anything, and keep in mind that this is a prototype that is not 100% finished or thought through. If you have a question or something is unclear, let us know. We encourage you to think out loud about

what you are thinking as you go through the prototype. We have a few exercises for you to conduct and would like to go through them now.

These are the exercises:

- You bought a new device and want to use it for a simple audio stimuli recording, so letting various people ranging of different ages listen to a 40 Hz and a 90 Hz sound to see what the differences in neural responses are in terms of age. For that you need to register a newly bought pair of headphones on the web app's platform. Can you do that for us in the prototype?
- Now that you registered the device you want to quickly test if it works and if brain data goes through, so you want something like a livestream.
- Now that you're looking at the livestream you want to know if the quality is good of the device, so e.g. if the earphone sits correctly in the ear.
- Now in order to record a simple experiment with a possible test subject you want to create a 10 seconds recording and then have a look at the data afterwards. Can you do that for us?
 - Please now access the eye movement data
 - Now you want to visualise the data, how would you do that?
 - Now you want to download the data, how would you do that?
 - What would you usually do after you downloaded such data? What are the tools you're working in?
 - What are pain points or limitations of these tools you work in after downloading such data?
- Now you want to setup a recording template for the hearing threshold experiment that you can reuse with other people. You also want to be able to upload sounds that can be played during the experiments at certain points. How would you do that?
 - What do you think is very important for creating such recording data sets?
 - Mention maybe markers, timestamps, time synchronisation etc.

- Now you recorded 20 experiments with 20 participants. you also always recorded the pulse rate of the recorded people and want to compare them with the recorded brain data.
 - How would you normally proceed in a situation like this?
 - Did you know that you can also upload other data sets such as videos, heart rate etc. to our platform to easily visually compare them? Can you do that for us please.

Style and Moodboard

Thank you so much for helping us understand how your mind works. In order to conclude the design questions we present you with a few example designs and moodboards from other apps and/or competitors and you need to choose your favourites. Please keep in mind that we encourage you to think out loud.

Conclusion

Thanks a lot for participating in our user interview session. You were very helpful and provided us with a lot of interesting insights. We will keep the provided information from you private and we will delete the recorded files in the next two weeks. You don't need to do anything anymore. Do you have any questions?

Notes

Intro notest:

Electrical engineering, medicine as a passion, now combining in med and engineering in in-ear devices, works as a researcher for UK dementia research institute, wasn't to make an in-ear device for people with dementia with dementia people, the ear signal is weak, and that's her biggest challenge now in work. also finishing phd, taking it to a different signal that is patent pending, everything focused inside the ear.

has covid

hear about IDUN by mutual friend, someone met Simon in MWC, understands that the electrode is the main USP.

She starts at the sensor, developed a protocol for the study objective, from 0 to 1, aim was to record overnight sleep for elderly patients, first making the sensors by hand, then design how the gold standard can be validated against. Collaborated with PSG systems, decided with the biocalibration protocols are, then conducted the sleep studies with subjects, had problems with the impedance of the system, then takes

the data and engineers the signal processing, looks at the data, challenges, starts statistics, looks at the scalp and then at the deep signals.

Looks at feature engineering, wants to develop automatic sleep scoring on an elderly cohort, everything is different as compared to healthy subjects.

In last study also included working with artifacts, for 24/7 recording there are many signal artifacts, and use the artifacts to better inform the

earpiece has electrodes and electrophones, sensor fusion to classify people wearing the earpieces and doing different activities, from a user perspective, gets a lot of data. It's very hard to get people to wear earpieces for all day and night.

What's the added benefit with EEG electrodes, common problem or question from patients. How can they rely on the product?

Where do you use open-source or own software?

Didn't want to be an engineer, but has to, everything is optimized for scalp EEG, uses Matlab and in-house data acquisition device very similar to OpenBCI ADS1299, use normal Matlab, whatever is available. Her input is in the features from the signal.

Did you ever think of deploying a system, deployable?

Role is research, no freedom to think of the market, but wants to go to a affordable and accessible device.

Feature engineering by hand.

Did you ever use software via API?

No, only local, no API or cloud, because you always have problems with ethics issues. University research laws, treated as patient data.

Uses a Cyton board to debug their data acquisition device and using the GUI, to test if it's running correctly as OpenBCI is an approved research platform. Just used GUI before or after experiments.

Are you missing anything software wise in the current chain?

What is missing is something dedicated for in-ear signals, from plots to GUI etc. Would like to see more frequency domain plots, not just time series, they have all the plots wants frequency plots on separate plots, need to remember the colors of different channels, separate frequency plot for each channel or annotation for each electrode

Would love to code (but wants to get results)

MIT inventor app, dragging and dropping is very nice to have

Never used psychopy, for testing tests sensors before going in the ear, uses research gtec biamp amplifier to test impedance, ECG to test the signal quality, then EEG with baseline recording with the subject.

Wants to build sensors for the ear, but would like to build multi-modal, microphone, PPG, accelerometer, gives so much insight because

Would like to have a development kit that has all the sensors instead of rebuilding the wheel

Has done automatic detection between focus and unfocused people with EEG, alpha-beta waves, number of eye blinks, etc.

Have you worked with other BCIs?

No, only in-ear EEG and verifying with scalp EEG, g.tec amplifier

g.tec decision made by the professor of the lab, they are always very responsive and helpful, great customer service

Have you ever done webdevelopment demos?

No

Primary development language is

Matlab, but going into Python

Did you get feedback from people reacting to your work with BCIs?

With people who know EEG they are very positive when they hear the results, engineers, doctors, etc.

Tech people are always very happy to see new tech

Whole different story talking to normal people, they are afraid of the depth of the earpiece in their ear. from generic to mounting on earbuds, measuring the it measure something physiological, people wonder if they will be electrocuted, apprehensive when it comes to putting in on the devices. accessibility is always an issue.

Also looks at hearing aids, there is a consistent positive feedback, since it's used as medical device already

When recording young people their age they are concerned about data and privacy but not in the over 40 age category. younger have more awareness about data privacy, personally she doesn't think about it take anything you want, for others it's an issue, what will you do with the data.

she developed different form factors from earbud to foam with silicon, to multi model with electrodes, accel and microphones

uses foam eartips

experienced latency with multi model data from multiple sensors, have to think about what parts synchronize,

Are you doing ML classifiers?

can use artifact classification example, after recording did offline and no automation data analysis,

How did you do the artifact classifier?

was done in matlab, knn classifier, predicted the classes.

Have you worked with VR?

no not yet but it's coming have funding from Meta

Would use IDUN if only EEG, like the inside ear reference and no wet electrodes

The first thing she would do with our device would be would hope for getting the device with software, click a few install, eyes open eyes closed to check the signal quality, then try alpha beta by games, etc.

third recording during a nap

if it passes then other

would assume that she wouldn't know what to expect with dry electrodes

do we use pdot?

to proceed with a measurement it would need to be less than 5 kOhm, anything higher is hard to deal with

If ML models are pre-trained and provided for you, would it be interesting?

depending on the purpose, as a user it doesn't matter but as a researcher to advance it, she would want to see what the underlying tech is

to be honest she would just be interested to having the sensors and explore her ideas, having good dry electrodes is most important

she would want hardware and raw EEG data stream

do you use ISI

no

with dementia

early onset detection eventually

manage, track progression of people, how it progresses what is accelerating it

Do you have questions for us?

she hasn't seen the software, only the material, likes the idea but feels the produce is under developed from looking at the website would like to see something more tangible

she saw our eye movement example

our linkedin is looks better than the website

would you buy headphones with eeg?

depends on what they do

might buy them or not

if she has access to the signals she would buy them, she bought an apple watch to have view of her heart condition but if it only said good or bad it would be different she bought it due to the watch offer the raw ecg data

Are you trusting companies?

Would always say yes to user agreement, doesn't believe it will matter as theyes so much data out there already in the world

lake of conver because she knows that the data ill be leaked one way or another, because imagine she turns off evey share settign in the pohne, but she gets targeted ads, so what privacy due we have?

believes this is how you make money and no one is realy caring about this and it will never stop so we just agree to use them and just accept it

Is most interested in getting the electodes

would you be interested in the next iteration

yes for sue