SUMMARY

Neurofeedback is used to learn people with neurodivergence to better understand their own brain. This can be done via the use of an electroencephalogram (EEG) which records the brain activity of a user and translates that activity into readable data. This data can then be used to compare the users brain activity to that of a non-neurodivergent person. At the moment, these types of training can only be done at a medical facility due to the technical nature of the application of the machine and the need for technical experience in this field of study. To also be able to use this type of treatment at home, the University of Münster started a project called "Braingomo" and in collaboration with the University of Twente, they want to develop a headset that can be used outside of these specialised locations, by people with ADHD. The headset is aimed to help children between the ages of 7 and 15 with the symptoms of ADHD, to use during the span of approximal 45 neurofeedback sessions. The research that was done in this thesis was executed in the scope of the Braingomo project and is based on the following main research question.

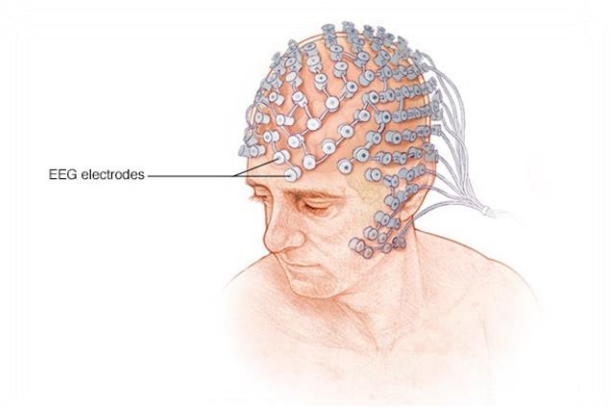

Figure 1 Diagram of a man wearing electrodes used during an EEG reading

"How can we design a size adjustable EEG headset for users between the ages of 7 & 15 years old suitable for neurofeedback sessions without the intervention of medical experts?"

To find an answer for this research question, this question was divided into 4 phases which are aimed towards the development of a concept and a prototype for the EEG headset. During the first phase the focus lay on researching both the target group and the current use of EEGs in neurofeedback. From this research it was learned that the main hurdle for children with ADHD is that they are easily distracted and that they find it difficult to sit still and focus on a single subject for a long time. They are easily distracted by extraneous stimuli and need high levels of stimuli to work on a large task. This means that they can be guided through a task more easily when these external stimuli are blocked out and they are doing a task that gives a lot of audio/visual feedback. Regarding the EEG systems and neurofeedback training the research went more in depth into the use and requirements for a (mobile) EEG system. These findings were later used in the second phase to give context to the research.

The second phase covers the stakeholder analysis and the market analysis. During this phase, the focus lay on giving the research context. This was done by looking at the stakeholders of the product. This did not only cover the user of the product, but also his immediate surroundings and other people who might be affected by the use of this product. This concluded in the fact that there needs to be a close cooperation between the school, the child, and its parent/caretaker. Not only due to the fact that children are at school a lot, but also because ADHD has a strong genetically determined nature and therefore the parents might be dealing with the same problems as the child. During the market research it was determined what the pros and cons of the currently available EEG systems are. From both the first and second phase a list of requirements was made, this list of requirements was the basis from which the ideation phase started, and the final product was evaluated.

The third phase was the ideation phase. During this phase, the goal was to create an eventual concept that would build on the pros from the already available systems and would also consider the ADHD specific requirements that were gleaned from the previous two phases. This phase eventually encompassed sketch ideating and rough prototyping. From the sketches a final idea was chosen which would combine the look and functioning of a pair of headphones with the electrodes from an EEG system. The rough prototyping was used to determine the more intricate mechanical parts of this idea. The headphone functionality can be used to shut out any extraneous auditive stimuli.

This led to the last part of this process, prototyping and the final design. To start the prototyping phase, the first thing that was made was a CAD-model. This was to get an idea of the final shape and test out if the imagined mechanisms would work, but also to create the parts that later would be made into the prototype. After having created this model, the parts were both 3D-printed and laser cut from sheet metal to later be assembled into the prototype. With this prototype the goal was to test the comfort with test subjects. This, however, unfortunately did not take place due to a lack of time and not having gotten ethical approval to do so.

Finally, the result of these 4 phases ended in the final product that realizes the defined aspiration from the research question, to have a mobile EEG system that children with ADHD can use during their neurofeedback sessions without the involvement of medical experts. To assess the usability and efficacy of the final product it is recommended to do an evaluation test in which both the comfort and the final look of the product are evaluated. It is also recommended to redo the prototype a bit smaller as to test the fit of the product with children. These testing sessions and prototype readjustments could not be performed in the scope of this thesis, but with the feedback from these sessions the next steps towards further development of the product can be made.

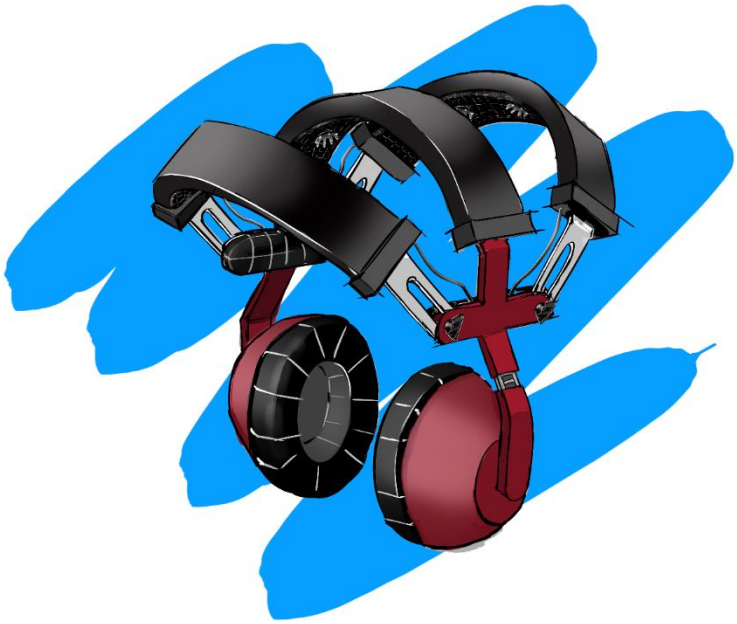

Figure 2 The final design of the headset