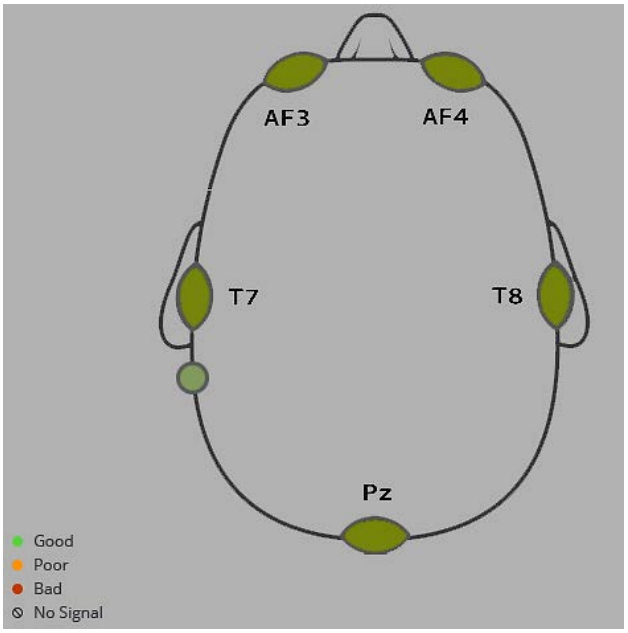

Fig.9: Emotiv Insight – good electrode contact quality.

4.5.1 Visual Stimuli – participant 1

Fig.10: Participant 1 – brain signals measured by Insight headset responding to visual stimuli.

The level of interest was almost identical throughout the measurement, except for an increase in the image of the sea. The level of engagement for pictures of love, cute bunny, and sea, has increased slightly and decreased in the picture of hedgehog in a mug. The level of stress remained steady for the whole time. The highest changes can be seen in relaxation. Excitement level fell down in pictures of funny dog and hedgehog in a mug. We can also see that the focus was jumping significantly in every change. A slight increase was observed in the picture of cute animals and funny dog, and from the other side, decrement was in the picture of the hedgehog in a mug and sea.

4.5.2 Visual stimuli – participant 2

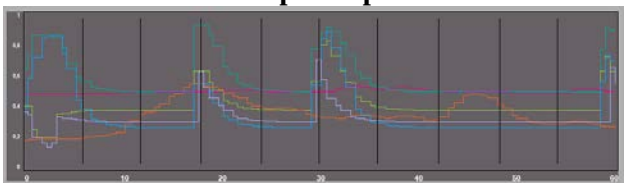

Fig.11: Participant 2 – brain signals measured by Insight headset responding to visual stimuli.

We can see on the graph that in the individual transitions between images are big changes, but only for some images. The interest is almost the same except for small fluctuations during the measurement. We can see a huge increase in engagement and relaxation in the picture of cute animals, starved kids, cute bunny and nature in the spring. We can see a jump in stress in images of starved kids and a cute bunny. An increased excitement can be seen in the picture of hedgehog in a mug and sea. The rise of focus can be observed in the pictures of starved kids, cute bunny and nature in the spring, while the decrease can be seen in the first picture of a cute animal. We can see that some signals are a bit inaccurate here and significant reactions are only on some images.

4.5.3 Auditory Stimuli – participant 1

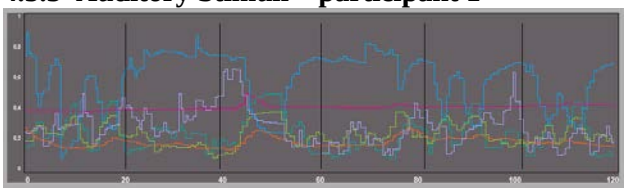

Fig.12: Participant 1 – brain signals measured by Insight headset responding to auditory stimuli.

On the graph, we can see huge fluctuations in individual types of music. An increase in interest can be observed while listening to death metal. The highest increase in engagement and stress can be seen while listening to death metal. The biggest fluctuations happened within the relaxation. The large increase in excitement can be seen while listening to death metal and fairy tale. High values in focus we see while listening to death metal and pop music.

4.5.4 Auditory Stimuli – participant 2

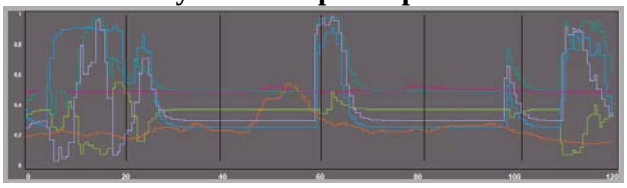

Fig.13: Participant 2 – brain signals measured by Insight headset responding to auditory stimuli.

We can see huge fluctuations in individual types of music. The interest level remained steady except for small fluctuations throughout the measurement. We can see that the engagement, relaxation, and focus increased individually according to the popular genre of the participant. We can also see a huge increase in relaxation while listening to relaxing

music. The stress level decreased most while listening to relaxation music and increased most for horror sounds. The highest increase in excitement was while listening to death metal.

4.6 Measurement in MyEmotiv

The measurement was performed with two participants. The first participant was a woman with long hair. The second participant was a man with short and thin hair. Length of the overall record was 4 minutes.

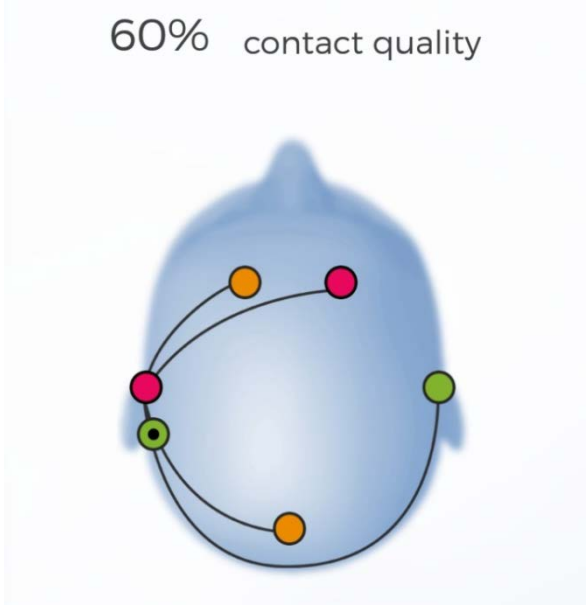

Fig.14: App MyEmotiv – bad electrode contact quality.

Fig.15: App MyEmotiv – good electrode contact quality.

4.6.1 Visual-auditory Stimuli – participant 1

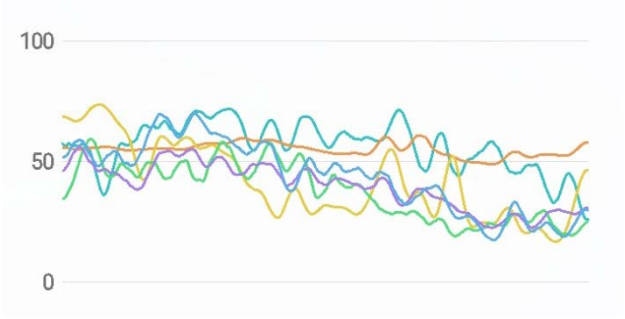

Fig.16: Participant 1 – brain signals measured by Insight headset responding to visual-auditory stimuli.

We can see reactions to various audio-visual stimuli on the graph. From the graph, we can see that the stress level dropped most in relaxation video and increased during the scary video. Engagement declined most at the end of relaxation video and increased in the video of real heroes. Interest was almost the same throughout the measurement except for the increase in the video of real heroes. We can see huge changes in excitement. The biggest increase can be seen in the video of real heroes. Focus has risen most in relaxation video and in a funny video. Most dropped was in the video of real heroes. From the graph, we can see that the greatest increase in relaxation was with relaxation video and the greatest decrease was with scary video.

4.6.2 Visual-auditory Stimuli – participant 2

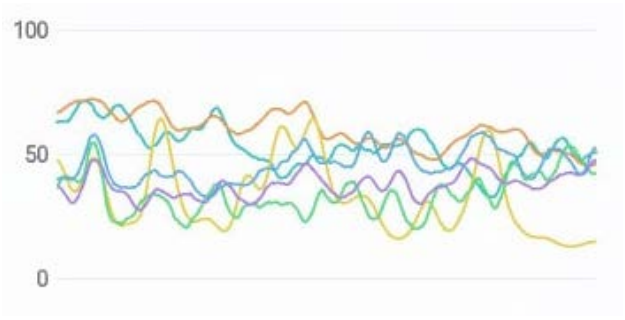

Fig.17: Participant 2 – brain signals measured Insight headset responding to visual-auditory stimuli.

On the graph, we can see huge fluctuations. We can see that stress levels have dropped in relaxation video and increased in the scary video. The engagement has risen highest for funny video and decreased for scary video. The level of interest has risen most in the funny video and the scary video. With the excitement signal, we can see large jumps throughout the entire scan. Focus increased most for funny video and decreased for relaxation video. In

relaxation, we can see an increase in the relaxation video and a decrease in the scary video.

From this data, we can see that the helmet processing the signals from the brain is quite accurate. However, the signals were recorded despite the loss of signal quality, which means that the data was not always correctly measured.

5 Discussion

BCI is defined as a combination of hardware and software that allows brain activities to control external devices or even computers. The objective is to help severely disabled people to live their life as regular people as much as possible. However, this area can also serve healthy people. The field of BCI is one of the important fields that deals with brain activities. It is expected that BCI applications will have a great effect on our daily life. In the last decade, technological advances in BCIs permit EEG acquisition by means of wireless, mobile, dry, wearable, and low-cost EEG headsets, with new potential daily-life applications. [8]

BCI can be used for many purposes in many areas, especially in the field of robotics and rehabilitation. One of the steps to optimize the BCI's capabilities, it should be used together with other up-to-date technologies (called hybrid BCI). [9] In another study was explored EEG headset device, Emotiv Insight, for its applicability in cognitive research. The conclusion was that the features and usability of the EEG headset are according to the research requirements. [10] Emotiv Insight is a very low-cost consumer-grade EEG device.

6 Conclusion

BCI is a very attractive area and common trend worldwide. In the last decade, technological advances in BCI allow new potential applications in everyday life (medicine, training, communication and control, rehabilitation, assistive technology, etc.). This study discusses the quality of the signals and the usability recorded using Emotiv Insight device. The experimental evaluation of the devices was performed with four participants. It was processed by six measurements. Measurement of all participants on visual, auditory and visual-auditory stimuli was performed by Insight headset. The first participant was a man with short hair. Set-up time was about two minutes. The second participant was a woman with long and dense hair. The device Insight was ready for use approximately after four minutes. The third participant was a woman with long hair. Set-up time was about three minutes. The fourth participant was a man with short and thin hair. The device was ready for use after approximately one minute.

The values of individual participants to various stimuli are very different. It may depend on what the participant preferences. Emotiv Insight looks visually good and there is a quick set-up. Nevertheless, on the other hand, the helmet is quite uncomfortable and pushes. Due to it is not recommended for medical or scientific purposes. The helmet processing the signals from the brain is quite accurate. However, the signals were recorded despite the loss of signal quality. It means that the data was not always correctly measured. Eventually, this study showed that the Insight is more suitable for entertainment.

There are plenty of applications for measuring brain signals as well. In this article was used software Emotiv Xavier ControlPanel and app MyEmotiv. Both of these applications are suitable for measuring brain signals, they are free and very user-friendly.

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