EMOTION RECOGNITION USING EMPATICA E4 SMART WATCH

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INTRODUCTION

For some individuals, e.g., autistic children, it is harder or not possible to express their feelings for reasons such as speech impairment or atypical facial expressions [1]. They are often misunderstood and which negatively affects their social lives. Therefore, help of an emotion recognition software could improve the quality of the interaction between their them and people in their social environment [2].

In this work, the smart watch E4 from Empatica was used to measure three different body signals: Heart rate, Skin temperature, and Skin conductance. We then tried to evaluate the correlation between these bio-signals and four different emotions; namely, Happiness, Sadness, Anger, and Pain. An important factor is that this watch is versatile and yet can be integrated to the daily life of these individuals without causing any impediment in their normal life.

DATA COLLECTION

For this work ten participants, all male and between 20 to 25 years old, took part in the experiment. They had to do watch six different short video clips and their reaction to them was measured in terms of their heart rate, skin temperature and skin conductivity. The experiment itself was divided into five phases. In each phase a different emotion of the following was measured: happiness, sadness, anger or pain. Each phase had the same procedure, the participant had to sit still for one minute so that his baseline could be measured. After the one minute was over the video started playing. At the end of each phase, the participant had to fill out a self-assessment form, about which emotion he just experienced and how strong he felt that emotions. Last, the participants got pinched in the arm to simulate pain.

DATA PROCESSING

In total 60 videos were shown to participants and ten samples of pain were solicited. Out of these data, 16 were marked with the emotion happy, 15 with sad, 8 with angry and 8 with pain. These marked data were analysed in two different ways: Continuous analysis and peaks statistics.

Continuous analysis This method analysed each second of the three measured signals. First, a mean value was calculated from ten seconds before the video started and then compared to each value after the start of the video. Every time the measured value was above the baseline a counter was increased.

The same was done if the value was below the baseline but with a different counter. In this fashion, we could measure if the signal has shown more increase or decrease.

Peak Statistics Only the Electrodermal activity signals have rapid changes in it, therefore, only for thwsw signals the peaks were analysed. Although the Electrodermal activity values are in a range from 0.1μS to 12μS, all the peaks have the same absolute height. Therefore, the peaks were characterised in three different sizes, small peaks from 0.1μS up to 0.4μS, medium peaks started from 0.4μS to 0.8μS and big peaks started at 0.8μS. An example of these three different heights is shown in figure 1.

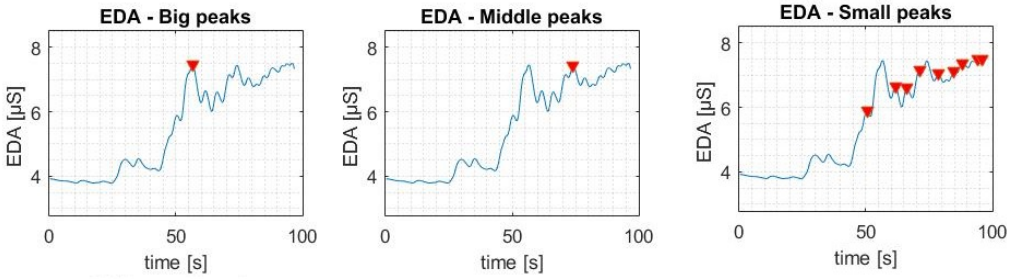

Figure 1: example of the peak detection

Result Table 1 summarizes the result of these analysis. With the information obtained through these analysis, an algorithm was created that could detect emotions out of these three bio-signals. The algorithm labeled 65% of the emotions with its first choice and 84% with the second choice right.

Table 1: Summary of the emotion of the data analysis

Emotion	Heart rate	Electrodermal activity	Electrodermal activity Peaks	Skin temp.
Happiness	slight increase	increase	small & few	slight decrease
Sadness	decrease	increase	small & many , big & few	slight decrease
Anger	slight decrease	increase	medium & some	slight decrease
Pain	no change	increase	medium & few	no change

References

[1] R. B. Grossman *et al.*, "Emotional facial and vocal expressions during story retelling by children and adolescents with high-functioning autism," *Journal of Speech, Language, and Hearing Research*, vol. 56, no. 3, pp. 1035–1044, 2013.

[2] R. Brewer *et al.*, "Can neurotypical individuals read autistic facial expressions? atypical production of emotional facial expressions in autism spectrum disorders," *Autism Research*, vol. 9, no. 2, pp. 262–271, 2016.