HAPTIKOS
HAPTIC VEST

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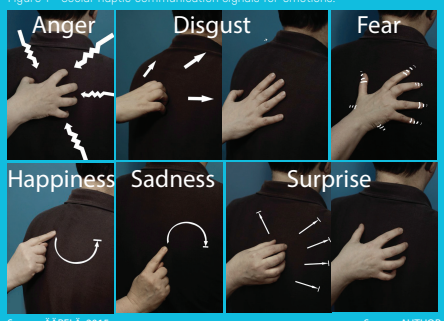
INTRODUCTION

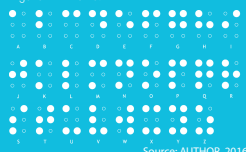
Deafblindness is a condition that hinders an individual's interaction with the people and environment that surrounds him or her. Interaction through touch, which is called haptics, is generally employed by deafblind communication methods. These include the block alphabet, Braille and social-haptic communication.

Figure 1 - Social-haptic communication signals for emotions.



Source: ÄÄRELÄ, 2015.

Figure 2 - Braille.



Source: AUTHOR, 2016.

Figure 3 - Block alphabet.

Source: AUTHOR, 2016.

PROBLEM

How to develop a system capable of conveying information using haptic communication automatically?

GOAL

Develop the prototype of a system that can convey information to the user by using haptic communication.

METHODOLOGY

The vest is made out of neoprene - a soft, flexible fabric - for comfort. The 10x10 vibration motor matrix is placed in the internal dorsal part of the vest using two strips of Velcro. The camera is fixed on the superior left corner of the frontal part of the vest.

Figure 4 - Block diagram.

Source: AUTHOR, 2016.

Figure 5 - Deafblind person wearing the vest.

Source: AUTHOR, 2016.

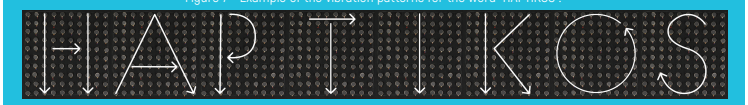
Figure 6 - Haptic vest.

Source: AUTHOR, 2016.

BLOCK ALPHABET

For the block alphabet and Braille communication, character input is done through a keyboard. It's also possible to adjust the speed of each character.

Figure 7 - Example of the vibration patterns for the word "HAPTIKOS".

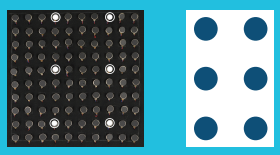


Source: AUTHOR, 2016.

BRAILLE

The vibration motors serve as points in a Braille cell, which vibrate individually to convey each character.

Figure 8 - Braille cell in the vibration motor matrix.

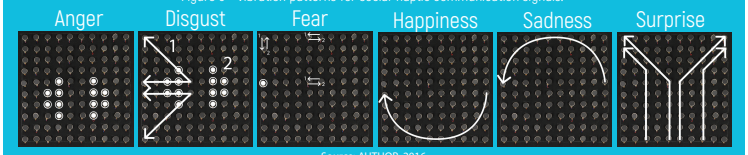


Source: AUTHOR, 2016.

METHODOLOGY

SOCIAL-HAPTIC COMMUNICATION

Figure 9 - Vibration patterns for social-haptic communication signals.



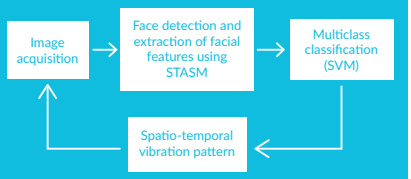
Source: AUTHOR, 2016.

FACIAL EXPRESSION RECOGNITION SOFTWARE

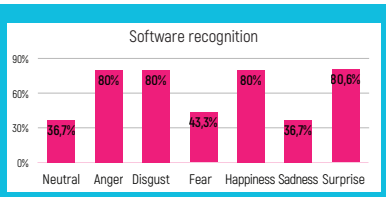
The classification classes are based on the six primary facial expressions of emotion according to Ekman and Friesen (2003): anger, disgust, fear, happiness, sadness and surprise, as well as neutral.

Figure 13 - MUG Facial Expression Database examples.

Source: AIFANTI, N.; PAPACHRISTOU, C.; DELOPOULOS, A; 2010.



RESULTS



Source: AUTHOR, 2016.

SOFTWARE

Average facial expression recognition rate for the 7 classes was 62.5%. The best recognized expressions were anger, disgust, happiness and surprise.

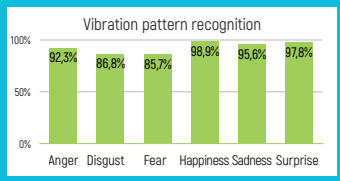
BLOCK ALPHABET AND BRAILLE

The average recognition rate for the 26 letters of the alphabet was 88% for the block alphabet and 84.6% for Braille.

The average recognition rate for words was 84% using the block alphabet and 74.5% using Braille.

SOCIAL-HAPTIC COMMUNICATION

In the learning phase, subjects took on average 1.23 trials to correctly recognize 5 out of 6 patterns. The average recognition rate in the test phase was 92.86%.



Source: AUTHOR, 2016.

CONCLUSION

The prototype built conveys information using social-haptic communication, block alphabet and Braille through a vibration motor matrix, automatically. The software recognizes facial expressions in real-time and controls the vibration motor matrix, according to the criteria.

The software evaluation results show that the recognition for "neutral", "fear" and "sadness" facial expressions can be improved.

The tests performed with the target group showed that the time required for learning the vibration patterns is short and that it is possible to distinguish between the different vibration signals. They have also proved that the haptic vest can be used to convey block alphabet and Braille characters.

These results point out the possibility of adding new features that implement the block alphabet and Braille, such as Optical Character Recognition (OCR) and voice recognition. Furthermore, they indicate the great impact that this project can have in deafblind people's communication, contributing to their development, accessibility and social inclusion.

REFERENCES

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