Towards Emotionally Sensitive Machines: The Use of Virtual Reality to Stimulate Human Emotions

Piotr Fratczak[1], Yee Mey Goh[1], Laura Justham[1], Peter Kinnell[1], Andrea Soltoggio[2]
[1]Wolfson School of Mechanical, Electrical and Manufacturing Engineering
[2]Computer Science Department
Loughborough University

1. Introduction

For effective human-robot collaboration, new machine control strategies are needed, so that machines can respond to the subtle emotional changes of the human co-worker. This research sets out to investigate how, by using Virtual Reality combined with biometric data, it may be possible to:

1. Elicit human emotions
2. Measure human emotions
3. Teach machines how to recognise human emotions
4. Improve efficiency and safety in Human-Robot Collaboration

This work addresses how we can reliably elicit human emotions in a lab environment.

2. How do we safely stimulate emotion?

Previous research has used pictures, music, videos and imagination and memories [1], which are limited by human attention.

Previous techniques:

- Pictures
- Music
- Videos
- Memories/Imagination

} Confounding factor: wavering human attention

To address this problem, the use of VR is investigated to exploit the key benefits of VR:

- Reduced outside world distractions
- Nearly limitless senario possibilities
- Can be interactive
- New VR systems are low cost and accesible
- It is safe for the participant

3. Methodology

I. Subjects are fitted with biometric sensors (fig. 1), and wear a VR headset (fig. 2).
II. Three virtual environments are generated to stimulate, fear and stress, excitement and relaxation.
III. During the experiment biometric data is logged to monitor physiological state.

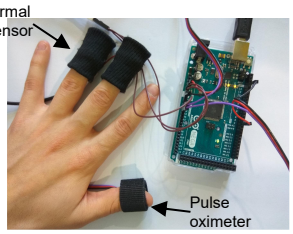

Figure 1: Measurement setup

Figure 2: VR Headset

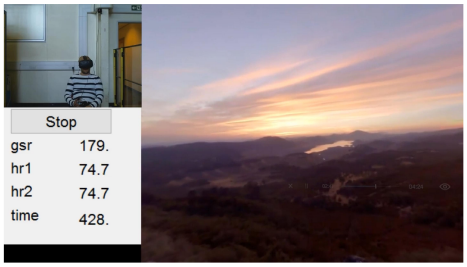

Figure 3: Scenario of relaxation

4. Relaxation

IMAGINE THIS: You are sitting comfortably, you look around and you see mountains, trees, lakes and a beautiful sunset. All you can hear is wind and relaxing music.

What do you feel?

5. Excitement

IMAGINE THIS: You are sitting comfortably, you look around and you see grassy plateau. Suddenly, a herd of wild Elephants appears in front of you. They're coming closer and closer, you think you could touch them, and yet you hope they can't touch you!

What do you feel?

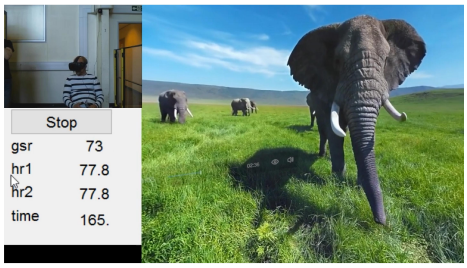

Figure 4: Scenario of excitement

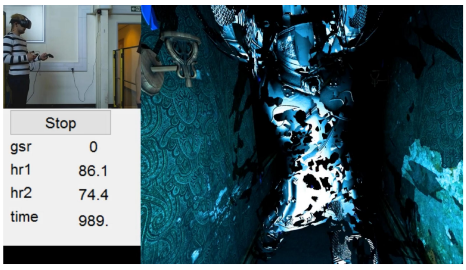

Figure 5: Scenario of fear

6. Fear and stress

IMAGINE THIS: you are walking through an old, dark mansion. Out of a blue, all the lamps around you shutter, pieces of glass are flying through the air. Suddenly you hear squeaky door shut down behind you. You look back, there's nothing there. You look ahead of you, a monster is jumping straight at your face!

What do you feel?

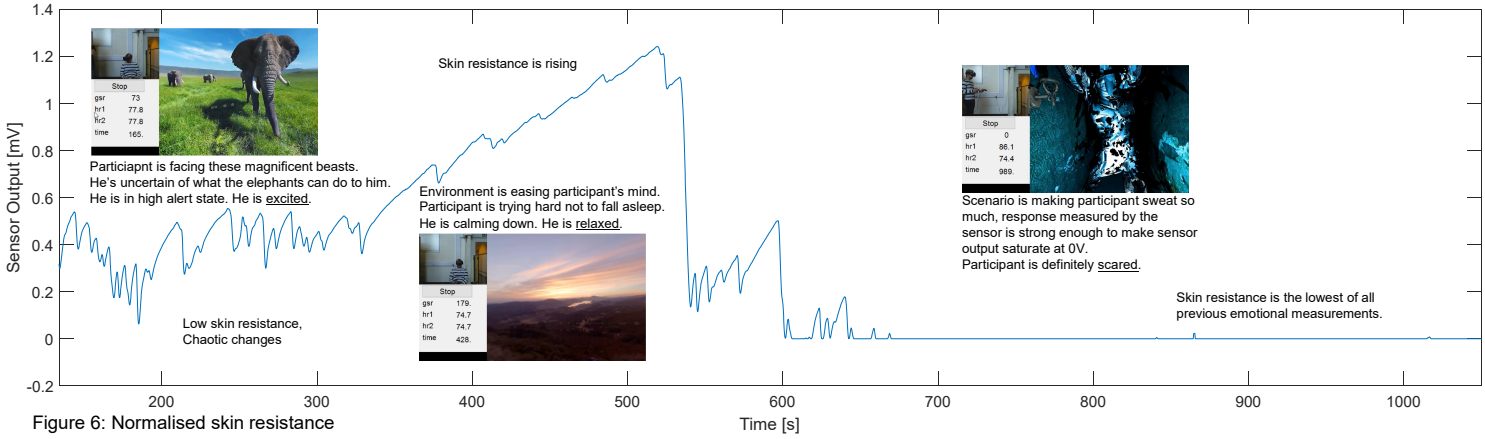

Figure 6: Normalised skin resistance

7. Results & Discussion

Fig. 6 shows a plot of skin resistance measured during the study. Three distinctive states can be observed, that are correlated to changes in the virtual environment. This suggests VR can have real impact on our emotional responses.

8. Conclusion and Future Work

Further work is needed to develop an effective set of virtual test environments and to define the most useful biometric measurements. Once this has been established, we intend to investigate the use of machine learning techniques to generate models of expected emotional state.

9. References:

[1] E. Meaux, P. Vuilleumier, "Emotion Perception and Elicitation." Brain Mapping: An Encyclopedic Reference, Oxford (UK): Elsevier, 2015