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Currently a PhD candidate at the Electronic Visualization Laboratory, I am focusing my research on exploring, designing and evaluating novel human augmentation techniques facilitated by technology. Aiming to overcome challenges of human computer interaction in the emerging technologies of wearable computers and human augmentation devices, and to improve quality of life for individuals with disabilities, I draw on a diverse set of skills, including scientific visualization, computer graphics, human computer interaction, electronics, sensors, fabrication and computer vision, in a field that is versed in Computer Science, Bioengineering, Psychology and Psychophysics.



Me at Pixar Animation Studios

INTRODUCTION

Umwelt, the German word for environment, is a psychology term referring to the individual's mental image of the surrounding world. This subjective universe is shaped by an organism's unique perception of the environment around them and, therefore, differs from individual to individual. In other words, organisms experience the world through their senses, construct the mental model of their vicinity, and react upon it. Hence, this image never remains static - instead it is constantly refined, as a result of the dynamic nature of the world. *Umwelt* is closely related to the concept of situation awareness, that is the perception of environmental elements, comprehension of their nature, and projection of their near future status with respect to time and/or space.



SpiderSense, a wearable tactile vest that alerts the user of obstacles and moving objects

Sensory perception (exteroception) of the surrounding environment is, as a matter of fact, restricted to the limitations of biological senses. For example, although we consider humans with five fully developed senses (sight, hearing, touch, smell and taste) as able-bodied individuals, they are actually impaired to a multitude of information that constantly surrounds them. To put things into perspective, both human sight and hearing, can only perceive a fraction of information - part of the electromagnetic spectrum (light waves), and of the sound frequencies, accordingly. However, as sensory systems differ among species, other creatures have an entirely different perceptual experience, as they are able to perceive a distinct spectrum of information.



HealthBar, a persuasive ubiquitous light tube that aims to improve the office worker's health

Despite the fact that our limited human senses restrict our *Umwelt* and, therefore, our situation awareness, Human Augmentics, referring to technologies that expand the capabilities and characteristics of humans, allows us to peek into an invisible "other" world, which is pretty big and unexplored. Thus, some important research questions arise: What would be the consequences of an expanded *perception of the surrounding environment*, and how would that affect an individual's situation awareness? Since our *Umwelt* is limited by genetics, how would individuals attune with characteristics and capacities that lie beyond the human range?

DISSERTATION

Being the largest organ of the human body with approximately 2 sq. meters of surface and weighing roughly 17% of the individual's total weight, the skin, is heavily underutilized compared to the use of visual and audio cues. While visual stimuli require the user's full attention and audio stimuli could muffle important environmental information, tactile stimuli enable hands-free discrete message transmission. The characteristics of mechanical skin stimulation that include its discriminative capacities, ability for fine temporal discrimination and the potency of touch for capturing attention, as noted by Geldard in 1957, enable its use as a communication medium.

For my dissertation, I am investigating the different ways that the skin could be used as a communication medium, and the consequences to the individual's situation awareness. **SpiderSense** developed in 2013 as my first investigation in this research topic, is a wearable tactile vest, consisting of 15 vibration modules and sensors that alerts the user of surrounding obstacles and humans using pressure feedback. User studies that followed showed that blindfolded subjects were able to safely navigate outside environments and avoid obstacles, as well as localize, aim and hit incoming attackers with projectiles. Building upon these research findings, for my thesis, I intent to build a new tactile vest, **SpiderSense 2.0**, that would allow finer control of variables during lab experiments. This new vest would enable precise measurements of the learning curve of the stimuli, and quantification of the individual's situation awareness during controlled lab experiments. My hypothesis is that, the wearer's situation awareness will over time improve as they are augmented through wearing the vest.

CONCLUSION

With the emergence of wearable technology and ubiquitous computing, the consumers have been flooded with wearable and pervasive devices that compete for the user's attention. Most of these devices use visual and audio cues for communication underutilizing the haptic capabilities of the skin, which has a great potential for message communication. My dissertation explores how the skin can be used as an informer, and measures the effect on one's situation awareness.