Biosensing, Enhanced Senses and Experience Design for Augmented Humans

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Abstract

The field of augmented humans is rapidly evolving, driven by advances in biosensing technologies, enhanced sensory capabilities, and innovative approaches to experience design. Real-time physiological feedback, adaptive environments, and augmented modalities—such as vision, hearing, and touch—are expanding human perception and interaction beyond natural limits. This workshop explores the intersection of biosensing, sensory augmentation, and human-centered design, with a focus on prototyping and evaluating experiences for augmented human interaction. We invite researchers and practitioners to share case studies, design approaches, applications, and methodological insights that contribute to this emerging area.

CCS Concepts

• **Human-centered computing** → *Empirical studies in collaborative and social computing*.

Keywords

Augmented humans, biosensing, enhanced senses, user experience

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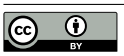

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1 Introduction

Human augmentation is an interdisciplinary field that addresses methods, technologies, and their applications for enhancing the sensing, action, and/or cognitive abilities of humans [24, 28]. Augmented capabilities can be realized through wearable systems, embedded sensors, and extended reality (XR) platforms that enable continuous sensing and multimodal interaction. These technologies allow, e.g., improved situational awareness, novel perceptual affordances, and new modes of interaction with both virtual and physical environments. The integration of AI, robotics and XR in augmenting humans creates both opportunities and risks [9, 15, 24].

Recent advances in ubiquitous computing have enabled a new generation of biosensing technologies that capture physiological and affective signals in real time, e.g., heart rate, respiration, muscle tension, brain activity, galvanic skin response, enabling systems that can interpret, react to, and communicate through bodily states. This provides opportunities for designing augmented experiences that are not only context-aware, but *body-aware*, facilitating more embodied, expressive, and emotionally tuned interactions.

These emerging capabilities challenge us to rethink the user experience (UX) beyond functionality and usability. As argued by Hassenzahl [11], UX includes both utilitarian and hedonic dimensions: it is about achieving goals as well as engaging meaningfully with technology. When technologies are worn, sensed through the body, or experienced viscerally, their design must consider affect, aesthetics, identity, and long-term integration into personal and social practices.

Motivations for exploring augmented humans range from assistive applications and mental health support to artistic expression, play, and self-exploration. For example ranging from vibrotactile compasses and breathing interfaces to speculative devices that extend perception into new sensory domains. When correctly harnessed, such technologies have the potential to reframe how we sense, feel, and relate to the world around us.

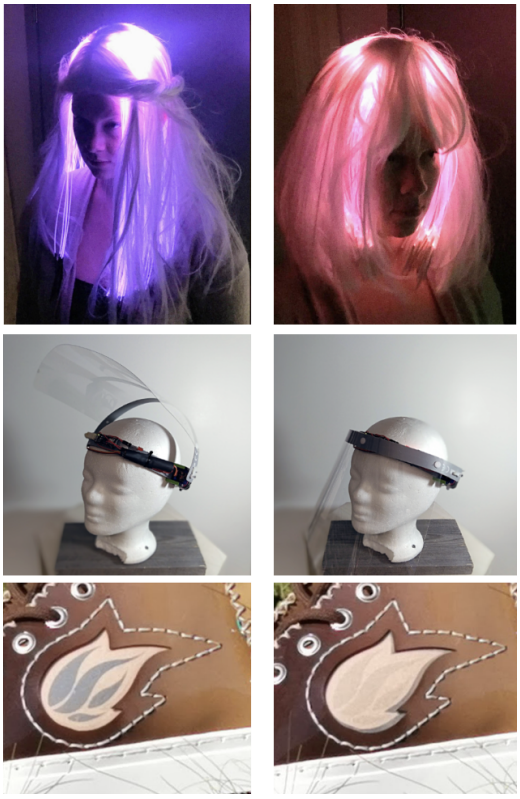

Figure 1: Examples of prior work related to the workshop theme: Variwig that changes color based on sensing the wearer's movements [2]; Facemask that closes when sensing covid coughing patterns [17]; VitaBoot's display changes to reflect the wearer's heartrate [13].

Technology acceptance in this space hinges not only on performance but also on subjective factors such as bodily comfort, interpretability, and social appropriateness. As biosensing and feedback systems become embedded in public and shared environments, they raise critical questions around privacy, consent, and inclusion—core concerns within the UbiComp community.

This workshop brings together an interdisciplinary community to explore biosensing, augmented senses, and experience design. We invite contributions that emphasize embodied, inclusive, and ethically-aware approaches, with a focus on real-world applications and culturally situated experiences.

2 The Topic

2.1 Augmentation of physical, sensory, and cognitive capabilities

Biosensing and neuroengineering, together with artificial intelligence (AI), provide enhancements to physical, sensory, and cognitive capabilities. Exoskeletons and biomechanical implants improve strength and endurance, while sensory augmentation through biosensing, bionic prosthetics, and brain-computer interfaces (BCIs) enhances perception and interaction with the environment. Cognitive augmentation, driven by cognitive-aware, adaptive UI, expands problem-solving, learning, and decision-making capacities [21]. These innovations will have profound implications for human potential.

Multimodal XR and BCIs are reshaping human perception, embodiment, and social interactions. By altering multimodal sensory experiences and extending bodily awareness, enabling new forms of self-representation and immersion in digital and physical environments [21]. Enhanced embodiment through haptic feedback [25] and neural integration fosters deeper engagement, while AI-driven social agents and virtual spaces redefine communication, interaction, and relationships. The recent PhysioCHI workshop at CHI2024, aiming towards identifying best practices for integrating biosensing in HCI, demonstrates the topic's timeliness [3].

2.2 AHs Design, User Experience and Social Aspects

The design of augmented human technologies is more than technical feasibility, including user experience (UX) and societal influence [1, 5, 22]. Augmented humans—individuals whose cognitive, sensory, or physical capabilities are augmented by technology—engage with digital systems in manners that transform perception, embodiment, and social interactions [5–8, 10, 20]. For instance, researchers examined methods to enhance students' design creativity by immersing them in virtual environments to stimulate their perception of culture. The findings revealed that stimulating students' perception of culture led to the generation of concepts for a product that are both innovative and feasible [7].

The user experience in augmented human systems includes utilitarian and hedonic perspectives [11], necessitating a balance of intuitiveness, comfort, and personalization. Utilitarian features emphasize functionality, efficiency, and dependability, ensuring that augmented technologies adequately fulfill users' requirements [23]. Concurrently, hedonic elements underscore pleasure, involvement, and emotional connection, rendering interactions both efficient and gratifying [30]. Virtual reality environments have become a useful tool to simulate the experience design of being an augmented human [18]. By combining different design elements in immersive virtual reality, different effects and experiences can be studied. For instance, in manipulating sensory feedback and experience e.g. as the function of movement, biofeedback, or, different [32]. Set-ups such as simulating G-forces on the human body [12], adapting the participant's vision and field of view [4], manipulating object weight by introducing temporal offsets [27], visual slow motion effects [14], and body dimensions manipulation [16] are examples of interesting techniques that can be harnessed for simulating augmented human experience in first person.

Augmented human technologies affect social relationships and cultural norms beyond personal experiences [19]. The incorporation of augmented senses in collaborative contexts, such as shared virtual worlds or distant communication, redefines human connectedness and the distinctions between physical and digital presence [29]. Nonetheless, concerns regarding digital inequality, privacy, and ethical implications arise as augmentation technologies gain attention [26, 31].

3 Rationale and Objectives

The examples provided in the prior section illustrate how different research topics can touch the augmented humans workshop theme. With this workshop, we wish to bring together researchers and practitioners, who have interest to progress the field further. The aim of the workshop is to gather together researchers, designers and practitioners that are working with human-robot interaction, and are particularly interested in the topic of human augmentation, biosensing related to adapting human behaviour, enhanced senses and capabilities, and aspects related to user experience and social interaction with augmented humans. As the objectives of the workshop, the workshop aims to be a forum to present existing cases, new possibilities, early research, challenges and lessons learned, and offer a stage where these questions can be discussed with peers and new colleagues with similar interests, and to strengthen the augmented humans research community among UbiComp researchers.

We encourage multi-disciplinary participation from different fields touching the augmented humans themes, and aim to provide an opportunity to network with new peers. The workshop invites researchers and practitioners with background in, but not limited to, HCI, computer science, design, psychology, and social science related to the augmented humans. The workshop invites submissions of case studies, applications, prototypes, sensing techniques, and methodological notes, related to topics such as

- interaction with augmented humans
- enhanced senses and capabilities
- biosensing for human behaviour adaptation
- multi-user and collaborative cases
- using XR for augmented humans research
- design and social aspects of augmented humans
- use cases and service concepts integrating augmented humans
- ethics in augmented humans HCI

4 Organizers

Jonna Häkkilä is professor at University of Lapland, Finland, Faculty of Art and Design. She conducts research at the cross section of design and technology, and is interested in the user experience design of futuristic topics in human-computer interaction. She leads Lapland User Experience Design research group (LUX).

Jani Mäntyjärvi is a Principal Scientist at VTT. His research interests are related to Machine Learning for wearable human sensing solutions for various application domains.

Zhengya Gong is a Postdoctoral researcher at the Faculty of Art and Design, the University of Lapland, Finland. Her work is focused on Extended Reality (XR) and Human-Computer Interaction, Design Creativity, Creative Methods, Design Cognition, Design Thinking, and Cultural Influence on Design.

Heiko Müller is a Senior Researcher at the University of Oldenburg, Germany. His work focuses on context-aware systems, HCI in applied settings, and multimodal interfaces, with experience from national and EU-funded projects in health and assistive technologies.

Kati Pettersson is a Senior Scientist in the Human Sensing Solution Team at VTT. Her research delves into computational applied psychophysiology, with a focus on head area sensing, visual perception, and oculomotor behavior.

Roope Raisamo is Professor of Computer Science at Tampere University, Finland, where he leads the TAUCHI research center. His work focuses on multimodal interaction, haptics, and human augmentation through multisensory technologies.

Ashley Colley is a University Researcher at the University of Lapland, Finland, with a background in UX design, wearable technologies, and mobile systems. He is a co-founder of Oura Health and has co-authored over 80 peer-reviewed publications.

Kai Kunze is Professor at Keio University, Japan. His research combines wearable computing, biosensing, and cognitive augmentation, exploring how technology can extend memory, attention, and perception in everyday contexts.

Albrecht Schmidt is Professor of Computer Science at LMU Munich, where he leads research on human augmentation, embedded interaction, and future user interfaces. He is a recognized leader in ubiquitous computing and human-centered sensing systems.

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