Wearables for Robots: Co-design Toolkit Exploration

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In this paper, we introduce the idea of using wearables with robots. We explore the concept through a co-design workshop, and discuss the possibilities for the future. Especially, we focus on describing the methods used in the workshop, which we found to be a useful toolkit for supporting initial ideation on the topic.

CCS Concepts: • **Human-centered computing → Systems and tools for interaction design**.

Additional Key Words and Phrases: Robots, social robots, wearables, co-design

1 INTRODUCTION

Wearables have emerged as an ever stronger area for computing devices, already with multitudes of different application areas. Prior research, as well as commercially available products, has introduced wearable devices related to health, wellness and sports, but also addressing use cases such as security, fashion, playfulness or self-expression. In this paper, we address, to the best of our knowledge, a new application domain, wearables for robots.

In our work, we focus on humanoid shape robots. The conceptual idea of using wearable computing for robots rises from the domain of social robotics. A social robot is an autonomous or semi-autonomous robot that communicates and interacts with humans, and aims to follow the behavioral norms set by humans [2]. Most of the current social robots are semi-autonomous, as they need at least partial operation or hosting by a human. Already, earlier research has demonstrated providing robots work place uniforms [8]. Taking a step beyond conventional clothing, wearables can provide a new dimension for interacting with robots and experiencing them. It also offers interesting opportunities for personalizing a robot according to its human user. Prior art has introduced four different attributes for customizing a wearable device, i.e. customizing its function, interaction technique, location on the body, and/or appearance [4]. In this paper, we present our preliminary work investigating wearables for robots. We take a co-design approach, and will report initial concepts for personalizing robots with wearables, and consider, what kind of toolkit would be suitable for such purposes.

2 CONCEPT EXPLORATION WITH CO-DESIGN APPROACH

To chart the initial ideas, we organized a co-design workshop, which addressed the initial ideas of use cases, preferences, and practicalities in customizing wearables for robots. We describe the methods used in the workshop, which focused particularly on the toolkit requirement for ideating customizable wearables for robots.

The co-design workshop included three tasks, which approached ideating wearables for robots from different viewpoints. In the first task, the participants assessed images of robots, which functioned as visual probes, Figure 1. Ideas were documented as post-it notes and further discussed in the participant group. The second activity was a concept creation task using a self-expression template [1] which focused on the use case of using social robots during remote teamwork. As the third task, we set the participants to brainstorm a concept and scenario using low-fi prototyping materials including a humanoid doll, Figure 2. This co-design task was conducted in groups of 3-4 people. After each task, a common discussion session was conducted.

The co-design tools used in the workshop functioned well for initial ideation, and inspired the participants to generate ideas and reflect on them. As the topic was fundamentally new to participants, we wanted to present tasks

Fig. 1. Robots used as visual stimuli for ideation.

Fig. 2. Low-fi prototyping materials and created concepts of robots with wearables.

which supported active participation with low threshold and encouraged creativity. Once we understand fruitful design directions which resonate with people, as the next step we can generate more refined design probes, to study specific scenarios and use cases. Eventually, this can lead to the development of requirements for a user toolkit, with which they could customize their personal robots or robot avatars, or add additional features through wearable technology.

3 DISCUSSION

We believe the concept of using wearable computing on robots raises new and interesting aspects to consider. Whereas self-tracking measurement is a key function of current wearable computing products for humans, e.g. sports watches and health trackers, with robot use cases this is less interesting. Rather, the robot wearables could be used to increase the expressive capabilities of the robots, as wearable computing has already been presented as a means to enhance self-expression through garments or accessories with a dynamic outlook. It has been reported that wearables should fit with and reflect the wearer's personality and style [5, 7], and that social acceptability is a key aspect to be considered in the design [7]. The social acceptability issues are likely quite different for robots using wearables, compared to humans.

Wearables can also help in communicating and interacting with a robot. With the robot's typically limited facial expression and body language, additional visual cues may be useful to ease the interaction and user experience with robots. For instance, research on robots for civic engagement emphasizes that the robot should express its purpose clearly, and showing emotions can be a supportive part of the design [6].

Personalizing digital avatars is already a huge phenomenon. With the personalization of virtual world digital avatars, the importance of providing options and creative freedom to customize body parts which are very visible and easily recognizable, e.g. hair, prevails [3]. It is interesting to consider that in the future, we could also see physical avatars in the form of robots. Wearable computing can provide tools to easily modify the outlook of such remote entities. In addition to expressing the style and personality, wearables could be used to provide dynamic information on the physical or mental state of the avatar owner.

To enable personalization of robots, it is beneficial to consider how to provide easy and expressive tools for end-users to carry out the personalization. Our workshop results will provide initial ideas on this. Eventually, this can help us to understand, e.g. what kind of elements and features could form a toolkit and how such wearable add-ons should be attached to a humanoid robot.

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