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# Design Fundamentals of Wearable Technology

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**Abstract.** Wearable technologies have the potential to integrate information that has meaning for people as they go about their everyday lives. In particular they can reflect aspects of the social environment, extending the periphery of the person and allowing them to experience social encounters with greater depth. This research concerns the indicative qualities of interactive clothing to support social relations in informal settings.

## Introduction

Wearable technologies have existed in some form since the late 1960s. From early heads-up displays and the personal information systems developed in research laboratories, to the popular emergence of e-textiles crafting in more recent years. Wearable technologies are typically embodied, in that they require consideration of physical form and the physical spaces people may occupy. They must also respect the viewpoint the wearer has on their world if they are to appropriately support relevant awareness. However, little attention has been given to the use of wearable technologies in public spaces and their effects on social relations. Their applications are numerous and varied, with the potential to be of value to wearers in everyday settings, including emerging work on interactive clothing.

My research concerns the design and indicative characteristics of interactive clothing, focusing on those designed for use in a social context. Social wearable technologies are devices worn on the body, to gather and display relevant information in a social environment. They stand to benefit their wearers and those in their presence by creating new opportunities for initiating, maintaining and discontinuing social relations. Social relations, in this context, focuses on co-located, in-person interactions between two or more people.

The research involves a series of iterative user-centred design and evaluation activities to articulate key parameters of interactive clothing as a social, wearable user experience. It has begun by building on a framework for designing around awareness and embodied user interactions in virtual environments, the Fahlén & Benford (1993) “Spatial Model of Interaction in Large Virtual Environments”(SMILV). The iterative activities will progressively articulate a new framework from this starting point to integrate qualities found in prior research on wearable technologies with new concerns exposed in my original empirical work on user experience in informal social settings.

- My overarching research question is:
  - How might interactive clothing support wearers to coordinate their joint experience as they move through an informal social space?
- To address this research goal, three questions are guiding my current approach
  - How can designers of wearable tech account for joint social use in informal settings?
  - What do designers and potential users of wearable technology consider to be the key parameters of wearer experience?
  - How does appropriateness of clothing effect the wearer experience?

## Related Work

It is widely accepted that the first example of wearable technology was conceived by Thorp and Shannon and designed to aid the wearer in a game of roulette (Thorp 1998). As the size of a cigarette packet, the device was worn inside the shoe with a wired connection to a small speaker by the wearer’s ear. Several other significant examples were created but serious research into wearable technology and their applications began in the 1990s. It was at this time that researchers began to explore how wearable technology might be used as a collaborative tool, often to augment face-to-face interactions. The wearer’s position in a social space and proximity to a person acts as a trigger for the wearable device to communicate supporting information. The wearable remembrance agent takes the form of a heads-up display and aims to support memory by presenting the wearer with contextually relevant texts (Rhodes 1997). The Hummingbird is an interpersonal awareness device worn around the neck or at the waist, intended to connect members of a group by supplying continuous visual and aural indications of whether other group members are close (Holmquist et al. 1999).

In the past ten years, the advancement and accessibility in e-textiles craft approaches have allowed wearable technologies to exist as interactive clothing, in which the technology is a fully embedded part of the garment (Mackey 2017, CuteCircuit 2009). The choices an individual makes about how they present themselves can affect their subsequent social interactions, both in how the individual is perceived by others and in how the individual feels about themselves (Goffman 1959). Self-presentation and choices of personal style can be better realised in interactive clothing. Prior research has often attempt to describe characteristics of wearable technology that could have general value, using terms such as sensing, perception, and hands-free. My analysis of the literature has identified at least 23 such terms however none point to an understanding of situated interactions and the nuances of meaning in embodied social encounters. My design and empirical work is thus organised around the problematics of wearable technology in informal social spaces so that the meaning and effect of interactive garments on interpersonal relations might be better understood.

## Work to Date

My work in this area over the last three years has involved prototyping garments with interactive components. Early empirical work, carried out whilst still an undergraduate student, involved attempts to adapt the SMILV for use in the design of social interactive clothing by varying parameters of awareness. Scenarios detailed how interactive clothing might control levels of awareness between the wearer and bystanders to evoke some social action, be that initiating, maintaining or discontinuing an encounter.

My most recent design activity has produced the Meetup Jacket: a prototype developed from scenarios based on café and gallery social interactions. The garment is intended for use in informal, social settings. It is an interactive garment that communicates feedback about proximity to a partner jacket through colour-changing LEDs. The aim is to increase awareness of friends when arranging to meeting up.

The Meetup Jacket was evaluated through a study involving two participants coming together in a cafe/gallery space at the University of Bath. The focus of this study was to investigate the social affordances offered by the device, alongside the influence of the wearers' perception of their self-presentation. One participant was seated in the cafe while the second participant made their way to the meetup location. Once the participants had come together, they were asked to walk around the gallery. This allowed insight into wearers' experience of the garment whilst moving around, stationary and with another wearer, demonstrating both the initiation of a social interaction and maintenance of the continued interaction.

Findings from the study were based upon some observations but mostly semi-structured interviews with the participant pairs after the main activities. Making observations was difficult as the study took place 'in the wild' in two

different locations simultaneously. Similarly in the second part of the study, the gallery space was small which made inconspicuous observation impossible.

An interesting area of research that emerged from the study findings was the enhanced awareness of social closeness afforded by the Meetup Jackets. Whilst moving around the exhibition space, several participants said that they had tried keep their meetup light green, thus staying closer together. The light changes to green when the wearers are within approximately two metres of each other:

“*Keeping in the green space.*” (P3)

The social meaning created by the joint display of green lights could be understood as a new “green space” of sociability.

## Towards Ethnographically Informed Design of Interactive Clothing

My research must now move towards a more coherent approach to studying how my designs may be appropriated by those who wear them. The case of the "green space" seems to show how meaning can be created as an effect of the designs I created; designs that respected and reflected human movement in a gallery space. I want my design work to create opportunities for meaningful interaction in informal social settings so hope that those who participate in my studies will help me gain insights for supporting this. I hope that my involvement in the ECSCW DC will help me to better frame both the idea of an informal social setting and the potential for using an ethnographic approach to inform my design work.

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