SenseBelt: A Belt-Worn Sensor to Support Cross-Device Interaction

Alexandros Stylianidis
Novoda
London, UK &
HCI Centre
University of Birmingham, UK
alexanderstyl@gmail.com

Jo Vermeulen
Department of Computer Science
University of Calgary, Canada &
HCI Centre
University of Birmingham, UK
jo.vermeulen@ucalgary.ca

Steven Houben
School of Computing and Communications
Lancaster University, UK
s.houben@lancaster.ac.uk

Lindsay MacDonald
Department of Computer Science
University of Calgary, Canada &
HCI Centre
University of Birmingham, UK
macdonla@ucalgary.ca

Russell Beale
HCI Centre
University of Birmingham, UK
R.Beale@cs.bham.ac.uk

Submitted to CHI 2017 Late-Breaking Work.

Abstract
Mobile interaction is shifting from a single device to simultaneous interaction with ensembles of devices such as phones, tablets, or watches. Spatially-aware cross-device interaction between mobile devices typically requires a fixed tracking infrastructure, which limits mobility. In this paper, we present SenseBelt – a sensing belt that enhances existing mobile interactions and enables low-cost, ad hoc sensing of cross-device gestures and interactions. SenseBelt enables proxemic interactions between people and their personal devices. SenseBelt also supports cross-device interaction between personal devices and stationary devices, such as public displays. We discuss the design and implementation of SenseBelt together with possible applications. With an initial evaluation, we provide insights into the benefits and drawbacks of a belt-worn mediating sensor to support cross-device interactions.

Author Keywords
Cross-device interaction; proxemic interaction; wearable computing; belt; sensors; ad hoc tracking.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Figure 1. SenseBelt connects to a user's personal devices (e.g., smartwatch, phone, laptop in their backpack).

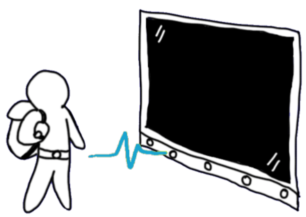

Figure 2. SenseBelt can sense other SenseBelt-enabled devices and notify the user via vibrations.

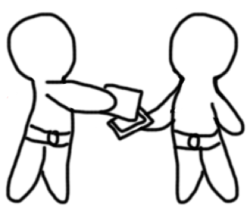

Figure 3. Two SenseBelt users exchanging a file via the "hand-over" and "pick-up" gestures.

Introduction

People increasingly interact with information through various devices [3], ranging from laptops, tablets, smartphones, and large surfaces to wearable technologies such as smartwatches and head-mounted displays. This proliferation of devices has led to situations in which individuals or groups interact with multiple devices simultaneously [14,17], both in collocated meetings and in mobile scenarios when users are on the go.

Prior work introduced techniques and infrastructures to facilitate cross-surface interactions [1,2,18,19,24–26]. However, these techniques often require fixed infrastructures to enable sufficiently accurate tracking [1,23,26], or are specific to certain applications or combinations of devices [2,20,28]. Infrastructure restrictions limit the possibilities for nomadic and mobile interactions in the wild. These techniques are designed around the principle of an *augmented space* [13] rather than from an ego-centric perspective [22] in which multi-device collocated interaction is centered around a person's body. There is a need to explore how these mediating tracking infrastructures can be designed, built and deployed in more naturalistic settings and mobile environments [12].

In this paper, we introduce *SenseBelt*, a belt-worn sensor device that supports ad hoc proxemic interactions [1] between groups of people and a wide range of different devices. SenseBelt is augmented with sensors to detect configurations of devices and people and support cross-device interaction techniques between ecologies of personal devices, stationary devices and spaces. The central goal of SenseBelt is to provide a new wearable personal mediating device that can detect various configurations of people and devices to provide better support for mobile collocated interactions in the wild.

SenseBelt Concept and Design Rationale

SenseBelt's design is based on the observation that the vast majority of personal and group interactions with devices happen within the action and observation space of a person, i.e., the space an individual can reach with their arms and clearly see [7,9,22]. To support collocated interactions, a system needs to be aware of what is happening in this region for one or more users. We therefore designed SenseBelt around three main design goals: *egocentric wearable tracking*; *proxemic interaction*; and *control and configuration*.

Egocentric Wearable Tracking

SenseBelt takes an egocentric perspective [22] in which a person's body acts as a reference for their interaction with their own personal devices and other devices and people in their environment. The person's own devices are connected to SenseBelt in a *body area network* (Figure 1). SenseBelt provides an embodiment of a personal information space around a person and enables communication with nearby devices and people in that person's visible surroundings. SenseBelt can send a person's identity and their orientation to nearby devices and people, allowing for interpersonal device tracking and enabling identification of people on the go without requiring instrumentation of the environment. As the pelvic girdle is the most spatially stable part of the body and generally oriented forward, it is the most suitable place for a spatial tracking device (versus e.g., a person's head). Similar to prior work [4,15,30], we therefore leverage the belt form factor for interaction.

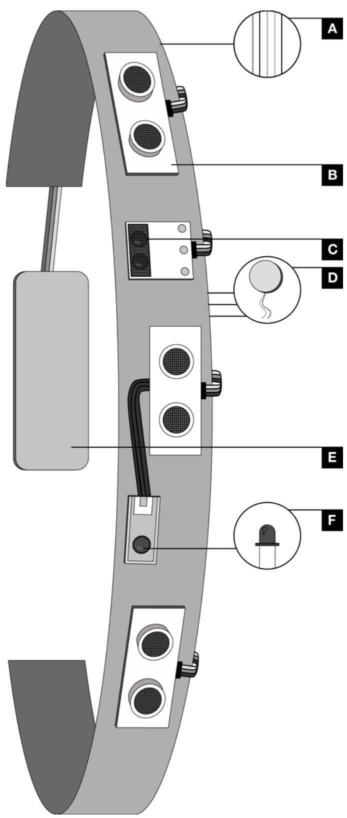

Figure 4. The SenseBelt components: (a) wires embedded into the belt, (b) 3 ultrasound distance sensors, (c) an IR receiver, (d) 3 vibration motors on the inner side of the belt, (e) an Arduino UNO with CC3000 WiFi shield, and (f) an IR LED.

Proxemic Interaction
To allow for proxemic and spatially-aware interaction, SenseBelt is able to sense multiple proxemic dimensions [7]: SenseBelt can track a person's *proximity* to another device, as well as their *orientation* and *identity*. Tracking of a person's identity allows devices to react specifically to that person: for example, a digital whiteboard can automatically load a person's previous session when they are identified via the belt (Figure 2). Tracking orientation and proximity allows a device to react only to people that are close to and facing the device. Furthermore, multiple SenseBelts can be merged when people interact in groups (Figure 3). While currently only implemented in a limited way to explore the concept, our goal is for SenseBelt to track the 3D spatial position of each device relative to the belt. This, together with the belt's other sensing capabilities, could enable a rich set of mobile cross-device interaction techniques.

Control and Configuration
SenseBelt was designed to provide users with control over their personal data and prevent surprises. We avoid exploiting knowledge of proxemics to the detriment of the user (e.g., flooding them with advertisements) [6]. To address privacy concerns, the user must actively show their intent to make a connection to another device (explicit *opt-in*) and can *opt-out* of that interaction at any time. As a wearable device, SenseBelt should be unobtrusive to wear and use and be acceptable in social situations, avoiding pitfalls of other wearable technologies such as smart glasses (e.g., Google Glass) [8,10].

Implementation
SenseBelt uses an Arduino UNO equipped with a CC3000 WiFi shield, an infrared (IR) LED for transmitting and IR receiver for receiving identity; 3 vibration motors for tactile feedback; and 3 PING))) ultrasound distance sensors (Figure 4). The unit pushes information from sensors to a Node.js server where a world model of a person's body area network of connected devices is kept.

Sensing Distance and Orientation
The PING))) ultrasound distance sensors on the belt are used to sense the distance and orientation of people and devices near the user. Each sensor's values are read at the same time. For person-to-person interactions, we use a threshold to ignore distances beyond the personal zone [1] (> 1.5m). In future iterations, we will support larger distances for person-to-device interactions. We assume the sensed device is at the side of the PING))) sensor where we register the closest distance. If two of the three sensors have similar readings (e.g., the front and left sensor), then the position of the device is treated to be in-between both positions (e.g., front-left). This gives us five detectable directions around the user: left, front-left, front, front-right, right.

Tracking Identity and Detecting Other Devices
A unique identifier (ID) is created for each SenseBelt and can be exchanged using the IR LED and IR receiver on the belt. In addition to being worn by people, the SenseBelt sensing components can also be integrated into other devices such as a public display (Figures 5 and 6). SenseBelt can detect nearby belts and devices by exchanging IDs. When SenseBelt-enabled devices are detected in the line of sight, the distance of the target is determined using the three ultrasound range finders. When a nearby SenseBelt-enabled target device is detected, the target's ID is forwarded to the

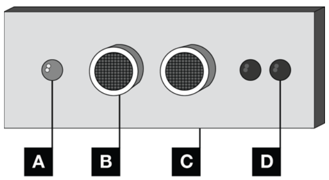

Figure 5. A SenseBelt tracking component can enable stationary devices to detect SenseBelt users: (a) IR LED, (b) ultrasound distance sensor, (c) built-in Arduino UNO, (d) IR receiver.

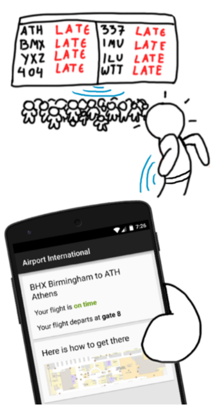

Figure 6. An airport information display equipped with a SenseBelt tracking component can provide personalized flight information with directions to the gate.

server. The Node.js server is also aware of each user's paired devices to their SenseBelt. In our current implementation, users can configure and connect their personal devices to the belt in a web interface on the Node.js server.

Cross-Device Gestures

A user can perform recognized cross-device gestures from any of their paired devices. If the two people's belts are "looking" at each other, the gestures performed by both users' groups of devices are compared. If they form an interactive gesture, a connection between both devices is initiated. To explore the feasibility of these cross-device gestures, we implemented an example gesture to easily share images from one device to another (Figure 3). Note that for the sake of simplicity, a SenseBelt currently does not track the spatial orientation of its paired personal devices. Gestures are detected on each device separately and transmitted together with a timestamp to the Node.js server.

Discoverability and Feedback using Vibration Motors

Discoverability of possibilities for interaction, i.e., knowing which devices are available and can be interacted with, is an important issue in cross-device interaction [5,11,16]. SenseBelt features three vibration motors distributed in the front half of the belt. Vibration motors have been explored previously in a belt form factor for navigation [30] and vibration patterns have shown potential for wayfinding [27]. SenseBelt provides *discoverability* of potential targets for interaction by vibrating one of the vibration motors individually when a user is standing in front of a device, or by vibrating several motors in series to indicate the direction of the target device when users are further away.

SenseBelt Applications

We implemented several prototype applications to demonstrate the possible applications of SenseBelt.

Location- and Identity-Aware Notifications

SenseBelt's identification capabilities and its coarse orientation sensing feature enable public displays to show relevant and targeted information to passersby. As shown in Figure 6, SenseBelt can augment the existing affordance of standing in front of an airport information display to provide targeted personal flight information on the user's personal device. A SenseBelt tracking component (Figure 5) can be positioned near the public display to sense SenseBelt users when they approach and face the display. After transmitting the user's SenseBelt ID, the display can then notify the user of the availability of targeted information. The information is pushed to the user's belt, which can then be transferred to and shown on the user's preferred mobile device (in Figure 6: the user's smartphone).

Similarly, a user standing next to a SenseBelt-enabled bus stop can sense the user's belt and provide localized and targeted information (Figure 7). The bus stop could ask permission to access the person's agenda stored in their smartphone and could use this to show the next bus which can take the user to their destination on time. SenseBelt-enabled exhibits could also be used to enhance museum visitors' experiences (Figure 9). The SenseBelt tracking component can provide additional information regarding the viewed exhibit, such as multimedia content, background information or a translation of the description.

Figure 7. A bus stop can provide personalized travel information.

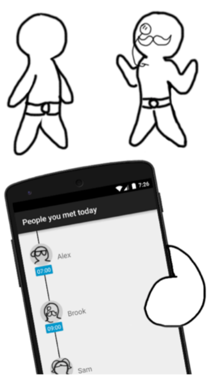

Figure 8. People you met today: collecting and exchanging contact details using SenseBelt.

People You Met Today
We implemented an application for SenseBelt to keep track of people you have met during the day, which could be useful for large conferences or business events (Figure 8). Public contact information can be configured to be automatically collected, or only after an initial gesture such as a handshake while wearing a smartwatch. The availability of this feature could be suggested to the user using geofencing when they enter the conference or by a SenseBelt tracking component near the door. At the end of the day, the user can access a log of all people they have met at the event on one of their personal devices (Figure 8).

Ad-Hoc Cross-Device Interactions
We implemented two cross-device gestures to facilitate person-to-person content transfer using people's mobile devices (Figure 3). These gestures are available once people are facing each other and their belts have exchanged IDs. Holding the phone (screen up) and slightly titling it towards the target acts as an offer of information to another user (hand-over gesture). Another user can then perform a pick-up gesture to transfer the content to their own device (Figure 3). Note that the need for an explicit offer gesture means that people are not sharing things without deliberately choosing to. When the receiver's phone is upside down, the device vibrates to indicate that the gesture has been recognized. The two gestures do not require perfect synchronization between the two ends of the interaction. Each user can perform their corresponding gesture almost asynchronously to the other. If the two gestures overlap at a certain point in time, the interaction begins. The offer gesture can also be performed towards other devices, such as printers, large displays, speakers and the examples discussed earlier (bus stop, airport, museum). Unlike users' personal devices, these (semi)-fixed devices [7] are configured to always accept offers from (authorized) users, although it is possible to configure limitations if desired.

User Study
We conducted a small study with 10 participants (4 female / 6 male, all students, varying levels of technical expertise) to gather feedback on the prototype.

Form Factor and Design
When trying on SenseBelt for the first time (Figure 10), participants had mixed feelings about the prototype. The design and form factor of the belt was considered important by most participants. Since a belt is a fashion item, participants expected a finished product. Overall, participants who tend to wear belts found the system natural. In the final interview, several participants suggested their own form factors to avoid having to always wear a belt (e.g., at home). As shown in Figure 11, participants suggested several ideas, such as an clip-on sensor connected to a bag strap, stickers to be placed on top of existing outfits without modifying them, and other form factors such as gloves, vests and sensing buttons on shirts (similar to [29]).

Participants did not seem restricted in their movements while wearing the belt. They could use their paired smartphones as they usually would without SenseBelt getting in their way.

Discoverability via Vibration Feedback
We began by exploring whether vibration feedback could suggest the direction of a target device. Participants received light vibrations in different patterns and were asked to identify the direction of the target de-

Figure 9. Exhibits in museums can push additional information to the user's device.

Figure 10. Participants trying out SenseBelt.

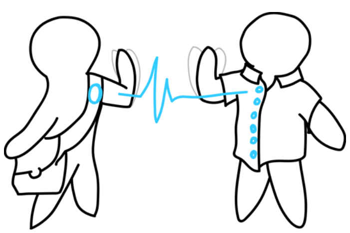

Figure 11. Some alternative form factors suggested by our study participants: a clip-on sensor, sensor buttons and stickers.

vice. All participants could easily identify stationary targets and had an approximate idea of where the target device was located in the study environment.

Cross-Device Interaction Experience

Participants were then asked to share an image from the experiment smartphone paired to the belt to the experimenter's smartphone. The hand-over and pick-up gestures (Figure 3) seemed natural for most participants. To share an image between the experiment smartphone and the laptop, some participants tried tilting the phone's display towards the laptop keyboard (similar to [19]) while others oriented the image on the phone's display towards the laptop screen.

Ease of Use and Privacy

In the final semi-structured interview, participants praised SenseBelt for its gentle learning curve. Participants were generally not concerned about privacy issues, although one participant expressed concern about the amount of data that SenseBelt would collect.

Future Work and Next Steps

Our SenseBelt prototype raises several further questions and opens directions for future research.

Spatial tracking of personal devices – To enable advanced cross-device interaction techniques that are possible with fixed tracking infrastructures [7,19,23], SenseBelt needs to be able to track the relative 3D spatial positions and orientations of its paired devices. We are experimenting with integrating an Inertial Measurement Unit (IMU) into the belt and calibrating and aligning the readings from the belt IMU to existing IMUs in the paired mobile devices. Another promising direction is the use of acoustic signals (e.g., Tracko [12]).

Form factor – The study demonstrated the importance of the device's form factor, convenience in everyday situations, and its overall design. People may find themselves in situations where it is inconvenient to wear a belt. A limitation of our current prototype is that the sensors can be occluded by clothing or the user's hands. It is an open question what the right form factor is for such a device. A promising direction is to explore miniaturizing the SenseBelt components into a clip-on version that can be worn on any clothing, similar to the Narrative Clip [32] (see also Figure 11).

Gradual Engagement – We can further refine discoverability feedback provided by the belt's integrated vibration motors. SenseBelt's egocentric perspective is well-suited for supporting *gradual engagement* [18] via continuous proxemic sensing. With gradual engagement, decreasing distance and increasing mutual orientation towards nearby devices and people is recognized to signal increasing engagement. The system provides peripheral awareness of interaction possibilities [31], which the user can act upon by simply approaching. This could be a way to avoid overwhelming the user in crowded environments with many devices and people that could potentially be interacted with.

Enhancing mediating capabilities – SenseBelt could be further extended to serve as a configuration mediator for an ecology of personal devices (e.g., to manage cross-device notifications [21] or configure a default personal device). We believe there is much potential to further explore the use of a wearable mediating device to enable rich and truly mobile cross-device interaction.

Acknowledgements

We thank Waldo Cervantes for his help with our initial prototypes of SenseBelt and David Ledo for feedback.

References

1. Till Ballendat, Nicolai Marquardt, and Saul Greenberg. 2010. Proxemic Interaction: Designing for a Proximity and Orientation-aware Environment. In *ACM International Conference on Interactive Tabletops and Surfaces* (ITS '10), 121–130. https://doi.org/10.1145/1936652.1936676

2. Xiang"Anthony" Chen, Tovi Grossman, Daniel J. Wigdor, and George Fitzmaurice. 2014. Duet: exploring joint interactions on a smart phone and a smart watch. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '14), 159–168. https://doi.org/10.1145/2556288.2556955

3. David Dearman and Jeffery S. Pierce. 2008. It's on My Other Computer!: Computing with Multiple Devices. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '08), 767–776. https://doi.org/10.1145/1357054.1357177

4. David Dobbelstein, Philipp Hock, and Enrico Rukzio. 2015. Belt: An Unobtrusive Touch Input Device for Head-worn Displays. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '15), 2135–2138. https://doi.org/10.1145/2702123.2702450

5. Hans Gellersen, Carl Fischer, Dominique Guinard, Roswitha Gostner, Gerd Kortuem, Christian Kray, Enrico Rukzio, and Sara Streng. 2009. Supporting Device Discovery and Spontaneous Interaction with Spatial References. *Personal Ubiquitous Comput.* 13, 4: 255–264. https://doi.org/10.1007/s00779-008-0206-3

6. Saul Greenberg, Sebastian Boring, Jo Vermeulen, and Jakub Dostal. 2014. Dark Patterns in Proxemic Interactions: A Critical Perspective. In *Proceedings of the 2014 Conference on Designing Interactive Systems* (DIS '14), 523–532. https://doi.org/10.1145/2598510.2598541

7. Saul Greenberg, Nicolai Marquardt, Till Ballendat, Rob Diaz-Marino, and Miaosen Wang. 2011. Proxemic Interactions: The New Ubicomp? *interactions* 18, 1: 42–50. https://doi.org/10.1145/1897239.1897250

8. Anisse Gross. 2014. What's the Problem with Google Glass? *The New Yorker*. Retrieved January 6, 2017 from http://www.newyorker.com/business/currency/whats-the-problem-with-google-glass

9. Edward T. Hall. 1966. *The Hidden Dimension*.

10. Jason Hong. 2013. Considering Privacy Issues in the Context of Google Glass. *Commun. ACM* 56, 11: 10–11. https://doi.org/10.1145/2524713.2524717

11. Steven Houben, Jo Vermeulen, Clemens Klokmose, Nicolai Marquardt, Johannes Schöning, and Harald Reiterer. 2015. Cross-Surface: Workshop on Interacting with Multi-Device Ecologies in the Wild. In *Proceedings of the 2015 International Conference on Interactive Tabletops & Surfaces* (ITS '15), 485–489. https://doi.org/10.1145/2817721.2835067

12. Haojian Jin, Christian Holz, and Kasper Hornbaek. 2015. Tracko: Ad-hoc Mobile 3D Tracking Using Bluetooth Low Energy and Inaudible Signals for Cross-Device Interaction. In *Proceedings of the*

28th Annual ACM Symposium on User Interface Software & Technology (UIST '15), 147–156. https://doi.org/10.1145/2807442.2807475

13. B. Johanson, A. Fox, and T. Winograd. 2002. The Interactive Workspaces project: experiences with ubiquitous computing rooms. *IEEE Pervasive Computing* 1, 2: 67–74. https://doi.org/10.1109/MPRV.2002.1012339

14. Tero Jokela, Jarno Ojala, and Thomas Olsson. 2015. A Diary Study on Combining Multiple Information Devices in Everyday Activities and Tasks. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '15), 3903–3912. https://doi.org/10.1145/2702123.2702211

15. Konstantin Klamka and Raimund Dachselt. 2015. Elasticcon: Elastic Controllers for Casual Interaction. In *Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services* (MobileHCI '15), 410–419. https://doi.org/10.1145/2785830.2785849

16. David Ledo, Saul Greenberg, Nicolai Marquardt, and Sebastian Boring. 2015. Proxemic-Aware Controls: Designing Remote Controls for Ubiquitous Computing Ecologies. In *Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services* (MobileHCI '15) from http://prism.ucalgary.ca/handle/1880/50351

17. Andrés Lucero, Matt Jones, Tero Jokela, and Simon Robinson. 2013. Mobile Collocated Interactions: Taking an Offline Break Together. *interactions* 20, 2: 26–32. https://doi.org/10.1145/2427076.2427083

18. Nicolai Marquardt, Till Ballendat, Sebastian Boring, Saul Greenberg, and Ken Hinckley. 2012. Gradual Engagement: Facilitating Information Exchange Between Digital Devices As a Function of Proximity. In *Proceedings of the 2012 ACM International Conference on Interactive Tabletops and Surfaces* (ITS '12), 31–40. https://doi.org/10.1145/2396636.2396642

19. Nicolai Marquardt, Ken Hinckley, and Saul Greenberg. 2012. Cross-device Interaction via Micro-mobility and F-formations. In *Proceedings of the 25th Annual ACM Symposium on User Interface Software and Technology* (UIST '12), 13–22. https://doi.org/10.1145/2380116.2380121

20. R. Mayrhofer and H. Gellersen. 2009. Shake Well Before Use: Intuitive and Secure Pairing of Mobile Devices. *IEEE Transactions on Mobile Computing* 8, 6: 792–806. https://doi.org/10.1109/TMC.2009.51

21. Abhinav Mehrotra, Jo Vermeulen, Robert Hendley, and Mirco Musolesi. 2015. Challenges in Managing Multi-Device Notifications. In *Cross-Surface: Workshop on Interacting with Multi-Device Ecologies in the Wild*.

22. T. Pederson, L. E. Janlert, and D. Surie. 2011. A Situative Space Model for Mobile Mixed-Reality Computing. *IEEE Pervasive Computing* 10, 4: 73–83. https://doi.org/10.1109/MPRV.2010.51

23. Roman Rädle, Hans-Christian Jetter, Nicolai Marquardt, Harald Reiterer, and Yvonne Rogers. 2014. HuddleLamp: Spatially-Aware Mobile Displays for

Ad-hoc Around-the-Table Collaboration. In *Proceedings of the Ninth ACM International Conference on Interactive Tabletops and Surfaces* (ITS '14), 45–54. https://doi.org/10.1145/2669485.2669500

24. Jun Rekimoto. 1997. Pick-and-drop: A Direct Manipulation Technique for Multiple Computer Environments. In *Proceedings of the 10th Annual ACM Symposium on User Interface Software and Technology* (UIST '97), 31–39. https://doi.org/10.1145/263407.263505

25. Jun Rekimoto. 2000. Multiple-computer User Interfaces: "Beyond the Desktop" Direct Manipulation Environments. In *CHI '00 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '00), 6–7. https://doi.org/10.1145/633292.633297

26. Jun Rekimoto and Masanori Saitoh. 1999. Augmented Surfaces: A Spatially Continuous Work Space for Hybrid Computing Environments. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '99), 378–385. https://doi.org/10.1145/302979.303113

27. Sonja Rümelin, Enrico Rukzio, and Robert Hardy. 2011. NaviRadar: A Novel Tactile Information Display for Pedestrian Navigation. In *Proceedings of the 24th Annual ACM Symposium on User Interface Software and Technology* (UIST '11), 293–302. https://doi.org/10.1145/2047196.2047234

28. Dominik Schmidt, Julian Seifert, Enrico Rukzio, and Hans Gellersen. 2012. A cross-device interaction style for mobiles and surfaces. In *Proceedings of the Designing Interactive Systems Conference*, 318–327. Retrieved June 10, 2015 from http://dl.acm.org/citation.cfm?id=2318005

29. Kashyap Todi and Kris Luyten. 2014. Suit Up!: Inconspicuous Interactions on Jacket Buttons. In *CHI 2014 Workshop on Inconspicuous Interaction*.

30. Koji Tsukada and Michiaki Yasumura. 2004. ActiveBelt: Belt-Type Wearable Tactile Display for Directional Navigation. In *UbiComp 2004: Ubiquitous Computing*, 384–399. Retrieved January 6, 2017 from http://link.springer.com/chapter/10.1007/978-3-540-30119-6_23

31. Jo Vermeulen, Steven Houben, and Nicolai Marquardt. 2016. Fluent Transitions Between Focused and Peripheral Interaction in Proxemic Interactions. In *Peripheral Interaction*, Saskia Bakker, Doris Hausen and Ted Selker (eds.). Springer International Publishing, 137–163.

32. Narrative Clip 2. *Narrative Clip 2 - the world's most wearable camera.* Retrieved January 6, 2017 from http://getnarrative.com/