How can we design displays that foster a sense of presence and awareness, enhance a sense of community and supports people to connect? The first prototypes that explored these questions were called media spaces, which connect several physical locations and the people working in those environments.

1st research question: **What types of media spaces were explored to enhance 'sense of community' among a group of people? Discuss similarities and differences.**

Keywords: awareness, togetherness, connectedness, presence

Starting point: **Ishii, H. et al. ambientROOM: Integrating Ambient Media with Architectural Space (CHI'98)**

Over the last decades, public displays became a part of our infrastructure: we find them in train stations, metro stations, and in public buildings. Most of those displays are used for static adds in the moment. Researchers work on novel technology to make those displays interactive. However, one challenge we still face is how to design the visual interface displayed to passer-byes in such a way that people understand that a display is available for interaction?

2nd research question: **What makes people understand that a public display is interactive? Discuss the proposed solutions in the literature.**

Keywords: understanding interactivity, expectancy

Starting point: **Müller, J. et al., Looking Glass: A Field Study on Noticing Interactivity of a Shop Window (CHI 2012)**

The next challenge is to rethink the way people actively interact with public displays: sometimes they use mobile phones, sometimes they use mid-air gestures. In order to understand what the next novel interaction technique is, we need to understand what had already been explored. What are the trade-offs between those techniques?

3rd research question: **What types of interaction techniques had been explored in order to interact with public displays? What tradeoff do they have?**

Keywords: public display, content generation, interaction technique

Starting point: **Müller, J et al., Requirements and Design Space for Interactive Public Displays (section Interaction Modalities)**

The number of personal portable devices has increased. Unlimited SMS and internet became affordable. Applications such as Twitter, Bluetooth, QR code scanner, etc. are installed on many mobile phones and can be used as posting mechanisms to large displays.

4th research question: **Which mobile phone posting mechanisms had been explored in research? Discuss the tradeoffs between those mechanisms.**

Keywords: public display, content generation, mobile phone, twitter

Starting point: **Munson, S. A et al., Thanks and Tweets: Comparing two public displays**

Public display interfaces so far focus mainly on playful interaction. What are public displays useful for in the future? Can we do more with it than passing time? What value can public displays add to our community?

5th research question: **Discuss the different benefit users have of current public display interfaces using projects from the literature.**

Keywords: public display, public engagement, content generation

Starting point: Greenberg, S., Rounding, M. The notification collage: posting information to public and personal displays. (CHI 2001)

Today's interfaces have shifted from keyboard and mouse input to direct manipulation using touch input. Although multi-touch technology is around since quite a while, it is interesting to observe that only a handful of multi-touch gestures made it into our everyday repertoire of input gestures, such as the pinch or swipe gesture. *Why is that? What are the problems of gesture input that we have to deal with as interface designers?*

6th research question: **What are gestures? How can we classify gestures and how were those gesture classes explored in interface design on interactive surfaces or in mid-air?**

Keywords: multi-touch gestures, gesture-based interaction

Starting point: Buxton, B., "Gesture-based interaction", chapter 14, (24.Aug. 2011). http://www.billbuxton.com/input14.Gesture.pdf

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One major issue with gesture input on interactive surfaces is that gestures can be hard to learn and difficult to discover. HCI research has worked out concepts, e.g. *self-revelation*, *guidance* and *rehearsal of gestures* to address these issues in gesture-based input design.

7th research question: **What are all the advantages and drawbacks of gesture based input on interactive surfaces (apart from fat-finger and occlusion (see below))? Which interaction techniques addressed the drawbacks you identified?**

Keywords: self-revelation, guidance, rehearsal of gestures.

Starting point: Bau, O., Mackay, W. *OctoPocus: a dynamic guide for learning gesture-based command sets*, UIST'08

An issue with touch-based input in general is the problem that our fingers perform less precise input than stylus input on a phone or mouse interaction on keyboard-and-mouse interfaces.

8th research question: **What is the fat-finger problem? And how was it addressed through interaction design in the literature? What are the trade-offs between the proposed solutions?**

Keywords: fat-finger problem, touch imprecision

Starting point: Siek, K., Rogers, Y., Kay, C. Fat Finger Worries: How Older and Younger Users Physically Interact with PDAs, Interact 2005

Touch imprecision comes in many cases also from the fact that we occlude the area we interact with when using direct touch interaction, the *occlusion* problem. However, we not only occlude information with our fingers when performing touch but also with our arms when interacting on larger interactive surfaces such as tablets or tables.

9th research question: **What are occlusion problems? And how are they addressed in the literature? What are the trade-offs between the proposed solutions?**

Keywords: fat-finger problem, touch imprecision, occlusion-aware interfaces

Starting point: Siek, K., Rogers, Y., Kay, C. Fat Finger Worries: How Older and Younger Users Physically Interact with PDAs, Interact 2005

Gestures are hard to remember. One possibility to reduce the cognitive load of gestures is to use 'intuitive gestures', gestures that are grounded in our already existing understanding of gestures. However, not all virtual commands can be uniquely represented by a gesture. How to represent the abstract command "print" as a 'natural' gesture? In this case, the literature offers a bunch of solutions to ease cognitive load using 'chunking' or 'feed forward' systems.

10th research question: **How does the literature address the design of abstract gesture sets for decreased cognitive load? What are the trade-offs between the proposed solutions?**

Keywords: feed forward, multi-finger chord, chunking

Starting point: Wagner, J., Lecolinet, E., Selker, T. Multi-finger Chords for Hand-held Tablets: Recognizable and Memorable, CHI 2014

The design of gesture sets is not focused on common interactive surfaces anymore such as mobile phones or tablets. A future trend is also the introduction of touch sensitive surfaces on wearable devices or the steering wheel in cars.

11th research question: **What types of gesture sets had been explored for wearable devices or interactive surfaces other than tablets or mobile phones. What are the trade-offs between the proposed solutions?**

Keywords: microinteraction, wearable computing

Starting point: Perrault, S., Lecolinet, E., Eagan, J., Guiard, Y. WatchIt: Simple Gestures and Eyes-free Interaction for Wristwatches and Bracelets, CHI 2013

Further, in some environments users are performing secondary tasks that occupy one of their hands. How should gestures be designed for busy-hand interaction and manual multitasking?

12th research question: **What are the effects of manual multitasking? How is it addressed in the literature? types of gesture sets had been explored for wearable devices or interactive surfaces other than tablets or mobile phones. What are the trade-offs between the proposed solutions?**

Keywords: microinteraction, manual multi-tasking

Starting point: Oulasvirta, A., Bergstrom-Lehtovirta, J. Ease of Juggling: Studying the Effects of Manual Multitasking, CHI 2011

Multi-surface environments are entire rooms equipped with interactive tables, tablets and wall-sized displays where people come together to collaboratively work on data.

13th research question: **What are the benefits of wall-sized displays depending on the task? What effect has display size on task-performance?**

Keywords: multi-surface environments, wall-sized display

Starting point: Liu C., Chapuis, O., Beaudouin-Lafon M., Lecolinet E., Mackay W.
Effects of Display Size and Navigation Type on a Classification Task, CHI 2014

The interaction with large displays in the context of public displays or large display interaction, requires users to interact either with what they have in their hands, e.g. hand-held devices, or to interact with their whole body, performing gestures in mid-air. How can we scope with this complexity of design alternatives in such environments?

14th research question: **What is the Body-centric Perspective on interaction design and how does it help to cope with the above-mentioned complexity?**

Keywords: body-centric, multi-surface environments, whole-body interaction

Starting point: Wagner J., Nancel M., Gustafson S., Huot S., Mackay M.
A Body-centric Design Space for Multi-surface Interaction, CHI 2013

When people collaborate in such multi-surface environments, they need to quickly exchange files and data. The challenge is to design an intuitive way for *cross-device interaction*.

15rd research question: **How is cross-device interaction explored in the literature? Discuss advantages and disadvantages of the proposed solutions.**

Keywords: cross-device interaction, multi-surface environments

Starting point: Marquardt, N., Hinckley, K., Greenberg, S. Cross-device interaction via micro-mobility and f-formations, UIST 2012

Many organizations are equipped with large displays – interactive whiteboards or Projection screens – to support collaboration in meetings. In this part of the seminar, we want to give an overview of research that explored the effect of different display setups on collaboration, e.g. people tend to have a territorial behavior on tabletops []. What other effects had been identified in the literature?

16th research question: **What did related work find on how the effect of screen orientation on collaboration? What collaborative tasks did they test? Discuss the findings.**

Keywords: electronic white-boards, collaboration

Starting point: Rogers, Y., Lindley, S. *Collaboration around vertical and horizontal large interactive displays: which way is best?* Computer 2004

Many group collaborations are mixed-focus collaboration activities, e.g. brainstorming, where group members transition between individual and shared tasks within a group. In order to design effective tools and interfaces for mixed-focus collaboration, we need an understanding on how collaborators are involved and engaged with each other.

17th research question: **How do mixed-focus collaboration groups coordinate their actions? Do group members behave differently on horizontal and vertical interactive surfaces?**

Keywords: mixed-focus collaboration, single display groupware

Starting point: Tang, A. et al. *Collaborative Coupling over Tabletop Display* CHI 2006

The software architecture and user interface design can become complex in multi-user, multi-device, and multi-application setups.

18th research question: **Which aspects need to be addressed when designing user interfaces for multiple users? Discuss examples where the identified aspects had been addressed.**

Keywords: multi-user, collaboration

Starting point: Bier, E., Freemann, S., *MMM: A User Interface Architecture for Shared Editors on a Single Screen* UIST 1991
