SIG: Spatiality of Augmented Reality User Interfaces

Alla Vovk
Oxford Brookes University
Oxford, UK
16022839@brookes.ac.uk

Danilo Gasques Rodrigues
UC San Diego
La Jolla, USA
gasques@ucsd.edu

Fridolin Wild
Oxford Brookes University
Oxford, UK
wild@brookes.ac.uk

Nadir Weibel
UC San Diego
La Jolla, USA
weibel@ucsd.edu

ABSTRACT

Augmented reality and spatial information manipulation is being increasingly used as part of environment integrated form factors and wearable devices such as head-mounted displays. The integration of this exciting technology in many aspects of peoples' lives is transforming the way we understand computing, pushing the boundaries of Spatial Interfaces into virtual but embedded environments. We think that the HCI community is ready for a renewed discussion about the role of Augmented Reality within Spatial Interfaces. With this SIG we want to expand the discussion related to Spatial Interfaces and the way they impact interaction with the world in two areas. First, we aim to critically discuss the definition of Spatial Interfaces and outline the common components that build such interfaces in today's world. Second, we would like the community to reflect on the path ahead and focus on the potential of what kind of experiences can Spatial Interfaces achieve today.

CCS CONCEPTS

• **Human-centered computing** → **Mixed / augmented reality**.

KEYWORDS

Augmented reality; spatial interface; spatial computing; interaction;

INTRODUCTION AND MOTIVATION

With the advent of cognizant and pervasive computing, the increased used of 3D printing and the establishment of user libraries like Thingiverse, and a strong push for wearable computing, the past five years have motivated a lot of innovation in user interfaces that seamlessly merge with the space around us. In this technologically-rich environment, we believe that the introduction of novel spatial interfaces fueled by novel augmented reality (AR) technology such as projection-based AR and smart glasses, represent a new wave of computing that is fundamentally different from the smartphone and tablet PC revolution. With this Special Interest Group (SIG), we seek to take stock of recent advances and gather the fragmented community to set a common research and development agenda able to propel through this next wave of Spatial User Interfaces.

In the past, multidimensional input devices were required for navigating and manipulating 2D or 3D graphical user interfaces and handling objects presented in virtual environments. With AR this perceptive barrier between input and output medium is no longer a hard one. Applications no longer have to draw the user in using direct mapping to lure the visuomotor cortex into feeling immersed. AR applications simply augment, or even replace, sensory experience, potentially removing the input/output barrier completely.

The understanding of what Spatial Interface is constantly evolving along with the emergence of new technology. While it was initially considered as an interaction medium for projection-based augmented reality [3], researchers have now a different view on what spatial interface means [5], and companies who create AR devices have different opinions on that as well.

In light of this new landscape, existing user interfaces paradigms are challenged, and the simple conversion of current smartphone and desktop apps into AR-enabled apps falls short of exploiting the real potential of Spatial User Interfaces. Many applications continue to use 2D user interfaces without leveraging the unique affordances that spatially-aware augmented reality applications can offer. With the adoption of AR displays, we think it is necessary to review our community's understanding of existing interfaces and define a new type of AR-based spatial interfaces.

With the increasing adoption of these novel AR technologies in daily life, we think the time is right to bring HCI researchers and practitioners together to rethink and redefine what spatial interface is. What 'spatial' means in the context of HCI and what are the new interaction scenarios.

OPEN CHALLENGES

Architecting user flows for a screenless, augmented world in which potentially the entire space around users becomes an interface, is fundamentally altering the relationship between humans and computers. In the near future, augmented reality displays will enable natural interaction with virtual content that is integrated with the surrounding real world, while users try to remain engaged with and aware of the real world [1]. This suggests that a promising direction for good design will arise from taking advantage of the immediacy and familiarity of everyday physical objects for effective manipulation of virtual objects [2, 4].

RETHINKING SPATIALITY FOR AR USER INTERFACES
TOPICS FOR GROUP DISCUSSION

In order to promote an engaged and productive discussion of Spatial Interfaces in AR, we suggest to focus group discussion on specific points that might help define unique properties. Table 1 outlines the detailed break down of our SIG, while we list the main themes we want to cover below. We expect the interdisciplinary nature of these topics to cater to the large CHI community, allowing people with different expertise to join our SIG.

- **Design approaches**. We expect participants to discuss topics including hybrid interaction techniques, two-handed interaction, and multimodal interaction.
- **Interaction tasks**. This topic covers potential task-specific interaction approaches. How can AR spatial interface be incorporated into different types of interaction tasks? Would it have similar components across distinct tasks?
- **Environmental component**. What are the different ways the environment influences or is influenced by these AR interfaces? Does the meaning of the content derive only from its connection with the physical world?
- **Involvement of the human senses**. AR is not restricted to augmentations of one particular human sense. What are the sensor limits that can be user in AR?
- **Technological advancements**. What are current and future technical challenges faced by devices? This topic covers device specifications, form factor, sensors, programming platforms, operating systems.
- **Enabling technologies**. How can HCI researchers leverage advancements in Computer Vision & Machine Learning to incorporate those in their research?
- **Psychology & Cognitive Science**. How can current literature in the field of psychology and cognitive science motivate and support the design of spatial interfaces? What are known and possible drawbacks of such interfaces?

Table 1: Tentative SIG schedule

t	Description
20	**Grounding the conversation** Introduce examples of spatial AR interfaces with the goal of grounding our conversation
20	**Breaking into groups** Interactive session with active involvement of the audience. The organizers will prepare creative material on the topic of SIG in order to stimulate discussions
20	**Redefining SIs** We will again reconvene as a room and discuss potential groupings of SI aspects and key future research topics
20	**Closing discussion** Summary of the SIG. We will also establish if there is an interest in hosting these sorts of SIGs or small events at future conferences

GOALS AND OUTCOME

The ultimate aim of this SIG is to connect researchers working on spatial augmented reality interfaces and start a discussion on how to best leverage new AR technologies as part of the current wave of computing. After the SIG, we will produce summaries of the discussed topics and share with attendees as well as online on a dedicated web site. To keep attendees in touch, we will ask participants to join our online community on *Spatial Interfaces* at spatialinterfaces.slack.com.

In summary our goals can be summarized as

- Initiate a dialogue about spatial aspects of the augmented reality user interface
- Explore and discuss specific underlying topics that influence Spatial Interfaces
- Connect researchers and initiate discussion among attendees to determine any post-CHI activities (e.g. running similar events at future conferences, establishing a web-based community forum, etc.)

EXPECTED ATTENDEES

We expect the event will be well attended by the following groups: 1) CHI attendees who conduct augmented reality research; 2) Practitioners working in the design/development of AR systems/products trying to address UI/UX in the different phases of development; 3) Industry representatives and domain experts from application areas.

We already reached out to prominent researchers and practitioners in academia and industry and invited them to attend our SIG at CHI 2019. We received overall good feedback and we expect many of them to participate. Their enthusiastic support and participation will be a key ingredient of the success of this SIG.

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