Proceedings of the 5th European Tangible Interaction Studio (ETIS) 2022

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1. Introduction

The sixth version of the European Tangible Interaction Studio was hosted by ENAC (Ecole Nationale de l'Aviation Civile, France) and took place onsite from November 6th to 10th 2022. In total there were approximately 50 participants attending ETIS from 15 countries (Belgium, Czech Republic, Estonia, France, Germany, Italy, Luxembourg, Netherlands, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom and the United States). The theme of the ETIS conference was "Ecological transition and mobility of the future".

Tangible Interaction is a research field addressing areas at the border of the physical and the digital. Nowadays many researchers, designers, developers and artists work in this area and a vast range of products and applications are designed and produced accordingly. Besides, many research projects are funded through research funds at a European and international level.

The aim of this meeting is to gather young European researchers in our field, to get them in touch with internationally renowned researchers and to establish networks for their future. This studio was a follow-up of the previous editions held in Bidart (2013), Fribourg (2016), Luxembourg (2017), and Siena (2020). The idea is to provide a unique opportunity to train in the field of tangible interaction and to discuss the research with professors and other young researchers.

Researchers with different backgrounds from both academic and applied/industrial research participated in ETIS 2022. The studio included voices from industry and private research institutions working in the field of tangible interaction. It aimed to provide participants with insights for applied research possibilities, in order to bring tangible interaction principles out of the lab, in the everyday use.

Senior researchers from the industry and internationally known professors introduced different topics related to tangible interaction from their different points of view.

2. Keynote speakers

Four keynote speakers were invited to participate in ETIS'22: Jörn Hurtienne (Julius-Maximilians-Universität Würzburg, Germany), Alan Dix (Cardiff Metropolitan University & Swansea University, UK), Wendy E. Mackay (Inria, France), and Kristina Höök (KTH, Sweden); the order is according they were presented during the Studio. The abstracts of the keynotes are presented below:

1. **Jörn Hurtienne**, Professor of Psychological Ergonomics at Julius-Maximilians-Universität Würzburg, Institute Human-Computer-Media

Title: Conveying the Abstract with the Physical: Primary Metaphors for Tangible Interaction

Abstract: More is up, important is big, honest is straight – so-called primary metaphors are mini mental models of how the world works. They connect the abstract (for example quantity, importance, moral behavior) with the physical-concrete (up-down, big-small, straight-crooked). Using primary metaphors, we can design human-technology interaction that is simultaneously innovative, inclusive, and intuitive. In his keynote talk, Jörn Hurtienne introduced the concept of primary metaphors based on image schemas, demonstrated their potentials for tangible interaction, and identified questions for further research.

2. **Alan Dix**, Professorial Fellow at Cardiff Metropolitan University and Director of the Computational Foundry, a project of Swansea University, Welsh Government, and the European Commission to promote ground-breaking digital research with a real impact on society

Title: Beyond the Wireframe: tools to design, analyse and prototype physical devices

Abstract: For many years interaction design was driven by the abstractions of WIMP (windows, icons, menus, pointer). The details differ on desktop applications, web pages or smartphones and the 'pointer' has evolved from mice to trackpad and touch-based interactions, however, for many digital applications, the central aspects are unchanged. What is different is that the screens we encounter, as Weiser predicted, are everywhere: embedded in physical appliances such as showers and toasters and situated in office walls and building facades. Furthermore, we are often engaging with digital applications that have no obvious screen or where the screen if present is only a small part of the interaction; these include voice assistants, semi-autonomous vehicles, and smart cities.

Even where the dominant interaction is focused on a screen, the nature of the interactive experience is fundamentally affected both by the places where we interact and by the physical activities we are doing: using a smartphone while sitting in an armchair and watching television, is very different from thumbing a quick message whilst walking down a busy city road on a rainy night.

In his talk, Alan Dix described several design techniques and prototype tools that seek to address the physicality of digital interactions including the physical nature of the device itself and the physical context in which it is placed. They included 'soft' formal methods to describe physical aspects of devices, ways to use video to model physical prototypes during early design and tools to encourage designers to keep the context of use in mind even when working on largely screen-based interactions.

3. **Wendy E. Mackay**, Research Director, Classe Exceptionnelle, at Inria, the French National Research Center for Computer Science

Title: Towards Intelligent Tangible Interfaces

Abstract: Rapid advances in artificial intelligence have led to a wide variety of intelligent systems, but too little consideration of their impact on the people who use them. Researchers from HCI and AI are working together on a new research area, « human-centered AI », which challenges traditional research paradigms and shifts the focus from better AI algorithms to better interaction with users. In her talk, Wendy Mackay discussed how we can design "human-computer partnerships" that take optimal advantage of both human skills and of system capabilities, and how to design and create such systems. She then discussed how this approach can be applied to the design of intelligent tangible systems.

4. **Kristina Höök**, Professor in Interaction Design at the Royal Institute of Technology, Stockholm

Title: Soma Design – intertwining aesthetics, movement and emotion in design work

Abstract: We are at a watershed moment: our relationship to technology is about to undergo a dramatic and irreversible shift. With the rise of ubiquitous technology, data-driven design, and the Internet of Things, our interactions and our interfaces with technology will look radically different in the years ahead, incorporating changes like full body interaction, shape-changing interfaces, wearables, and body- and movement-tracking apps. Kristina Höök discussed how we approach this challenge through Soma Design — a process that allows designers to examine and improve on connections between sensation, feeling, emotion, subjective understanding and values — and their relationships to technology. She argued that by engaging in a soma design process we can better probe which designs lead to: deepened somatic awareness; social awareness of others in the environment and how they are affected by the human-technology assemblage; enactments of bodily freedoms rather than limitations; making norms explicit; engage with a pluralist feminist position on who we are designing for; aesthetic

experience and expression; and, ultimately an aesthetic and ethical position on how to design for being human.

3. Panel

In line with the conference theme, ETIS 2022 included a panel on the topic "Tangibility and industrial downsizing". Three panelists were invited to present their position: Anne Roudaut, who is professor of Human-Computer Interaction and head of the Bristol Interaction Group in the Computer Science Department at the University of Bristol, UK; Martin Hachet, who is senior researcher (DR2) at Inria Bordeaux, member of LaBRI and team leader of Potioc (Inria, CNRS, Univ. Bordeaux); and Aurélien Tabard who is associate Professor at Université Lyon 1, member of LIRIS (Université Lyon 1 & CNRS).

Anne Roudaut discussed how tangible object design is still tech-led and not material-centric enough in contrast with non-digital objects, mainly because we are used to take available electronic components. She illustrated a material-centric approach where e-ink was recycled from broken e-readers and presented how to use more versatile and accessible tools to fabricate with raw electronic materials such as e-pigment, morphing or sensing materials. Finally, she showed how bringing fabrication tools and knowledge to end-users could bring more user self-awareness of materials and how we consume them (changing the way we fix & recycle, reverting to a hacking society).

Martin Hachet presented his current project using mixed-reality and experimental economics to encourage pro-environmental behaviors. In this approach, experiments based on game theoretical models and mathematical predictions which are scientifically validated protocols ensure strong internal validity of decision making and behavioral patterns. They may help to isolate and test pro- and anti-social behavior, to integrate both individual and institutional (managerial) decision making and to take into account the behavior of many participants interacting with the context but also among themselves. This was for instance illustrated by the common resources game in which a resource that benefits all can be appropriated by self-optimizing individuals.

Aurélien Tabard talked about situated visualization of pollution, including various data from sensors to bioindicators. He discussed the limitations of current approaches (terrible sensing quality, senses only one specific chemical element, high variability in space, limited representations, tech driven community approach, naive discourse on empowerment). Then, he presented the use of lichens as living sensors, indicative of nitrogen deposition (NOx) from either anthropogenic or natural sources, and how to turn the environment into a visualization (biomonitoring). He explained that the latter approach has many benefits, including engagement and strong relationship to context, scalability in space (from bacteria to trees) and in time (little to no maintenance required over years), integrated sensing, processing and display abilities, and built-in messiness that surfaces sensing challenges.

The second part of the panel allowed participants to express their ideas through an online brainstorming on the miro platform (https://miro.com/), with a board prepared by Laetitia Bornes, PhD student at ENAC. Post-it notes written by ETIS attendants where classified into categories relevant to the problem, and aligned along the axes of the X-curve model which represents the transition processes in crisis contexts.

4. Paper Sessions

Three paper sessions where held during ETIS'22, which were thematically categorized. We present them here in the order that they were presented during the conference:

Session 1: Design principles, chaired by Ellen Do, director of partnerships and innovation with the ATLAS Institute at the University of Colorado Boulder.

- Wo Meijer
  Destructive Feedback
- Diego Casado-Mansilla, Filipe Quintal, Mary Barreto and Augusto Esteves
  Thinking about Eco-feedback and Smart Plugs via a Survey and Thematic Analysis

- S. Sandra Bae, Danielle Szafir and Ellen Do
  Exploring the Benefits and Challenges of Data Physicalization

Session 2: Design theories, methods & tools, chaired by Valérie Maquil, Senior Researcher at Luxembourg Institute of Science and Technology (LIST)

- Stéphanie Rey, Anke Brock, Brygg Ullmer and Nadine Couture
  A heuristic design grid for past and future uses of Token+Constraint systems
- Vincent Ferrari, Valentin Braud, Laurent Bovet and Nadine Couture
  Tangible Interaction and Embodied Cognition challenged by remote control issues
- Ahmet Börütecene
  Wizard of Oz with Strong Magnets: Exploring Haptic Interactions with Non-Humanoid AI Agents

Session 3: Tangible systems, chaired by Augusto Esteves, Assistant Professor
Instituto Superior Técnico, Uni. of Lisbon

- Maudeline Marlier, Sébastien Mahler, Nicolas Renoir, Martin Hachet and Arnaud Prouzeau
  Tangible interactions in control centres for railway traffic management
- Daniel Echeverri
  Tangible Narrative: The Intersection of Performance, Interactivity, and Narrative—A Design Case

5. Workshops

The following seven workshops took place during ETIS 2022:

- *Make-A-Morph: Exploring the design space of inflatable devices made from planar fabric* (Zacharie Guillaume, Théo Richalet, Marc Teyssier, Sylvain Pauchet, Jérémie Garcia and Benoit Roman)
- *Re-envisioning Interaction in the (General) Aviation Cockpit through Tangibles* (Sebastian S. Feger, Christopher Katins, Philippe Palanque and Thomas Kosch)
- *Workshop on Tangible xAI* (Leonardo Angelini, Nadine Couture, Mira El Kamali, Quentin Meteier and Elena Mugellini)
- *Designing Data Physicalisations – using physical Image Schema Instantiations* (Cordula Baur, Carolin Wienrich and Jörn Hurtienne)
- *Designing wearable interactions through playful on-body explorations* (Barbro Scholz, Michaela Honauer, Kristi Kuusk, Paula Veske and Seçil Uğur Yavuz)
- *Expanding the design possibilities of tabletop tangible user interfaces* (Jeremy Laviole and Quentin Gobert)
- *Dronible: Operating drones with Tangible objects* (Jérémie Garcia, Nicolas Viot, Dong Bach Vo and Sylvain Pauchet)

6. Conference Theme

The theme “Ecological transition and mobility of the future” was chosen as the conference theme for ETIS’22. Mobility was an obvious choice because ETIS’22 was hosted at ENAC, the French university for civil aviation. In the past years, ecological transition has become a priority for ENAC in order to attenuate the impact aviation has on the climate of our planet. The two main parts of the conference theme were represented in the program through the following aspects:

Ecological transition:

- Paper « *Thinking about Eco-feedback and Smart Plugs via a Survey and Thematic Analysis »* (Casado-Mansilla et al.)
- Panel "Tangibility & industrial downsizing" (see section 3)
- Decision to use public transport rather than renting busses
- All breaks offered a vegetarian or vegan option

Mobility of the future:

- Visit of « Cité de l'espace » (Space City) in Toulouse
- Paper « *Tangible interactions in control centres for railway traffic management »* (Malier et al.)
- Workshop *"Tangible Interaction in the (General) Aviation Cockpit"* (Feger et al.)
- Workshop *"Dronible: Operating drones with Tangible objects*" (Garcia et al.) in the ENAC flight hall
- Visits of the simulators of air traffic control and aircraft at ENAC

7. Organization

Finally, we present the local organization committee, the steering committee of ETIS, as well the program committee, which peer-reviewed the ETIS submissions and thus guaranteed the high quality of the contributions.

Organisation Committee

- General Chair: Anke Brock (ENAC, Université Toulouse, France)
- Program Chair: Catherine Letondal (ENAC, Université Toulouse, France)
- Scientific Editor: Valérie Maquil (LIST, Luxembourg)
- Local organization: Marcos Serrano (IRIT, Université Toulouse, France) & Dong-Bach Vo (ENAC, Université Toulouse, France)
- International Chair: Tanja Döring (University of Bremen, Germany)
- Webmaster: Timoteo Couture & Sylvain Pauchet (ENAC, Université Toulouse, France)
- Technical support & Logistics: Florence Laporterie-Dejean & Hélène Weiss (ENAC, Université Toulouse, France)

Steering Committee

- Nadine Couture (ESTIA Recherche, LaBRI)
- Elena Mugellini (HES-SO, HumanTech)

Scientific Commitee

- Leonardo Angelini (HEIA-FR, Fribourg, Switzerland)
- Anke Brock (ENAC, Université Toulouse, France)
- Nadine Couture (ESTIA, Bidart, France)
- Maxime Daniel (ESTIA, Bidart, France)
- Augusto Esteves (ITI / LARSyS, Instituto Superior Técnico, Portugal)
- Martin Hachet (Inria, Bordeaux, France)
- Eva Hornecker (Bauhaus-Universität Weimar, Germany)
- Dietrich Kammer (HTW Dresden, Germany)
- Sophie Lepreux (LAMIH, IUT de Valenciennes, France)
- Catherine Letondal (ENAC, Université Toulouse, France)
- Maud Marchal (Univ. Rennes / INSA / IRISA, France)
- Patrizia Marti (University Siena, Italy)
- Valérie Maquil (LIST, Luxembourg)
- Elena Mugellini (HEIA-FR, HumanTech, Fribourg, Switzerland)
- Maud Poulin (HES SO, Fribourg, Switzerland)
- Stéphanie Rey (Berger Levrault, Labège, France)
- Brygg Ullmer (Clemson University, USA)

8. Acknowledgements

We would like to thank all our sponsors without whose financial support this event would not have been possible. First, our champion sponsors Université franco-allemande / Deutsch-Französische Hochschule (UFA / DFH) and ENAC (Ecole Nationale de l'Aviation Civile). Moreover we are grateful for the financial support by HEIA-FR / HumanTech / HES SO (Fribourg, Switzerland). Many thanks also to AFIHM (Association francophone en interaction humain-machine), IRIT (Institut de Recherche en Informatique de Toulouse) and MasterIHM Toulouse. Finally, we thank ESTIA (Bidart, France) for the scientific support.