Ubiquitous Mixed Reality
Designing Mixed Reality Technology to Fit into the Fabric of our Daily Lives

Avec le soutien de la Fondation Mines-Télécom

Jan Gugenheimer | Télécom Paris / LTCI / Institute Polytechnique de Paris
Ubiquitous Mixed Reality:
Human-Computer Interaction and our Path Towards Ubiquitous Mixed Reality
Human

Mobile

Personal

Mainframe

Computer
Human Computer Technology coming closer to the Human
Human

Computer
Ubiquitous Mixed Reality:
Or how Facebook (sorry I mean META) calls it: The Metaverse
Ubiquitous Mixed Reality:
How do we get there?
Ubiquitous Mixed Reality: New types of Input
FaceTouch

Jan Gugenheimer¹, David Dobbelstein¹, Christian Winkler¹², Gabriel Haas¹, Enrico Rukzio¹

¹Institute of Media Informatics, Ulm University, Germany
²Daimler Protics GmbH, Stuttgart, Germany

In Proceedings of

UIST 2016

Enabling Touch Interaction in Display

Fixed UIs for Mobile Virtual Reality
FaceTouch
Enabling Touch Interaction in Display Fixed UIs for Mobile Virtual Reality

Jan Gugenheimer¹, David Dobbelstein¹, Christian Winkler¹², Gabriel Haas¹, Enrico Rukzio¹

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In Proceedings of UIST 2016

Artifact
Modified Oculus DK2 with touch digitizer

Empirical
Two Fitt’s Law Studies on accuracy (n=18) and mounting position (n=18)

Theoretical
Three example applications, exploring the Design Space
FingerMapper
Enabling Arm Interaction in Confined Spaces for Virtual Reality through Finger Mappings

Wen-Jie Tseng, Samuel Huron, Eric Lecolinet, Jan Gugenheimer
Télécom Paris, Institut Polytechnique de Paris, France

Demo (Extend Abstract) at CHI 2021
Poster at IEEE VR 2022

Artifact
Two different mappings between finger and arm

Empirical
Two Fitt’s Law Studies on accuracy (n=18) and mounting position (n=18)

Theoretical
Three example applications, exploring the Design Space
Ubiquitous Mixed Reality:
New types of Feedback
GyroVR
Simulating Inertia in Virtual Reality using Head Worn Flywheels

Jan Gugenheimer¹, Dennis Wolf¹, Eythor R. Eiriksson², Pattie Maes³, Enrico Rukzio¹

¹Institute of Media Informatics, Ulm University, Germany
²TU Denmark, Lynbyrg, Denmark
³MIT Media Lab, Cambridge, USA

In Proceedings of UIST 2016

Artifact
Modified Oculus DK2 with flywheels of old HDDs

Empirical
One mounting study (n=12) evaluating:
Enjoyment, Immersion and Simulator Sickness

Theoretical
Three example applications and mapping techniques exploring the Design Space
CarVR
Enabling In-Car Virtual Reality Entertainment

Philipp Hock, Sebastian Benedikter, Jan Gugenheimer, Enrico Rukzio
Institute of Media Informatics, Ulm University, Germany
In Proceedings of CHI 2017

Artifact
Sensing car using IMU and OBD Reader + Samsung GearVR

Empirical
Comparing driving condition vs standing (n=23) in terms of enjoyment, immersion and simulator sickness

Theoretical
Design space exploration and design guidelines
Ubiquitous Mixed Reality:
New types of Collaboration
ShARE: Enabling Co-Located Asymmetric Multi-User Interaction for Augmented Reality Head-Mounted Displays

Pascal Jansen\textsuperscript{1}, Fabian Fischbach\textsuperscript{1}, Jan Gugenheimer\textsuperscript{2}, Evgeny Stemasov\textsuperscript{1}, Julian Frommel\textsuperscript{3}, Enrico Rukzio\textsuperscript{1}

\textsuperscript{1}Ulm University; \textsuperscript{2}Télécom Paris – LTCI, IP-Paris; \textsuperscript{3}University of Saskatchewan
Ubiquitous Mixed Reality:
How do we get there?
Human

Computer
Research Question: How to shape and design the technology to create a desirable, usable and pleasant system and interaction concept for Ubiquitous Mixed Reality technology
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Research Question: In case Ubiquitous Mixed Reality technology will be widely available. What potential negative implications has the technology on the human and how can we overcome these downsides?
Ubiquitous Mixed Reality
Potential negative implications around Privacy
Exploring Augmented Visual Alterations in Interpersonal Communication

Jan Ole Rixen¹, Teresa Hirzle¹, Mark Colley¹, Yannick Etzel¹, Enrico Rukzio¹ Jan Gugenheimer²

¹Institute of Media Informatics, Ulm University, Germany
²Telecom-Paris/IP-Paris/LTCI

Accepted CHI 2021

Empirical

(N=64), we measured the user's comfort, acceptance of altering and being altered, and how it is impacted by being able to perceive or not perceive the alteration

Opinion

“Should we have the ability to alter the visual appearance of our conversational partner even if its only perceived by us”?

Discussion of the potential implications for future Technology
Exploring Augmented Visual Alterations in Interpersonal Communication

Jan Ole Rixen¹, Teresa Hirzle¹, Mark Colley¹, Yannick Etzel¹, Enrico Rukzio¹

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¹Institute of Media Informatics, Ulm University, Germany
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Accepted CHI 2021

Should we have the ability to alter the visual appearance of our conversational partner even if its only perceived by us? 

Empirical (N=64), we measured the user’s comfort, acceptance of altering and being altered, and how it is impacted by being able to perceive or not perceive the alteration.

Opinion

Mixed Reality can **not** be explored and evaluated from a **single user** perspective! There is always someone that is augmenting and someone that is augmented.

How do you feel about when I am able to change your appearance and see your most recent social media footprint?
Ubiquitous Mixed Reality
Potential negative implications around Safety
Understanding the Experience of Breaking Out of Virtual Reality Safety Boundaries

Wen-Jie Tseng, Petros Dimitrios Kontrazis, Samuel Huron, Eric Lecolinet and Jan Gugenheimer

Telecom-Paris/IP-Paris/LTCI

In submission UIST 2022

Artifact

We developed an application that is able to induce “breaking out” experiences in the lab

Empirical/Theoretical

We ran an online survey (n=148) and created a first framework to explain breaking out experiences which we verified in a consecutive lab experiment (n=12)
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Understanding the Experience of Breaking Out of Virtual Reality Safety Boundaries

Wen-Jie Tseng, Petros Dimitrios Kontrazis, Samuel Huron, Eric Lecolinet and Jan Gugenheimer

Telecom-Paris/IP-Paris/LTCI

Submitted to CHI 2022
The Dark Side of Perceptual Manipulations in Virtual Reality

Wen-Jie Tseng¹, Elise Bonnail¹, Mark McGill², Mohamed Khamis², Samuel Huron¹, Eric Lecolinet¹ and Jan Gugenheimer¹

¹ Telecom-Paris/IP-Paris/LTCI
² University of Glasgow

In proceedings of CHI 2022

“Virtual-Physical Perceptual Manipulation (VPPM) refers to Extended Reality (XR) driven exploits that alter the human multi-sensory perception of our physical actions and reactions to nudge the user’s physical movements.”

**Theoretical**
We define, conceptualize and demonstrate the existence of Visual Perceptual Manipulations in the field of HCI and XR

**Empirical**
Using speculative design workshops, we explore and characterize the threats/risks posed, proposing mitigations and preventative recommendations against the malicious use of VPPMs

**Artifact**
We implement two sample applications as an evaluation-by-demonstration showing how existing VPPMs could be trivially subverted
Research Question: How to shape and design the technology to create a desirable, usable and pleasant system and interaction concept for Ubiquitous Mixed Reality technology.

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