MR/VR/AR Technology for Humans

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XRIM Lab

- Extended Reality and Interactive Media
- Focus on AR, VR, Empathic Computing, and Gaming
- 2 primary approaches
  - Technical
  - Human

Background

- Masters in Telecommunications (2012 - Grenoble, France – Turin, Italy)
- PhD Computer Networks (2016 - Grenoble, France)
- Postdoc AR (Hong Kong)

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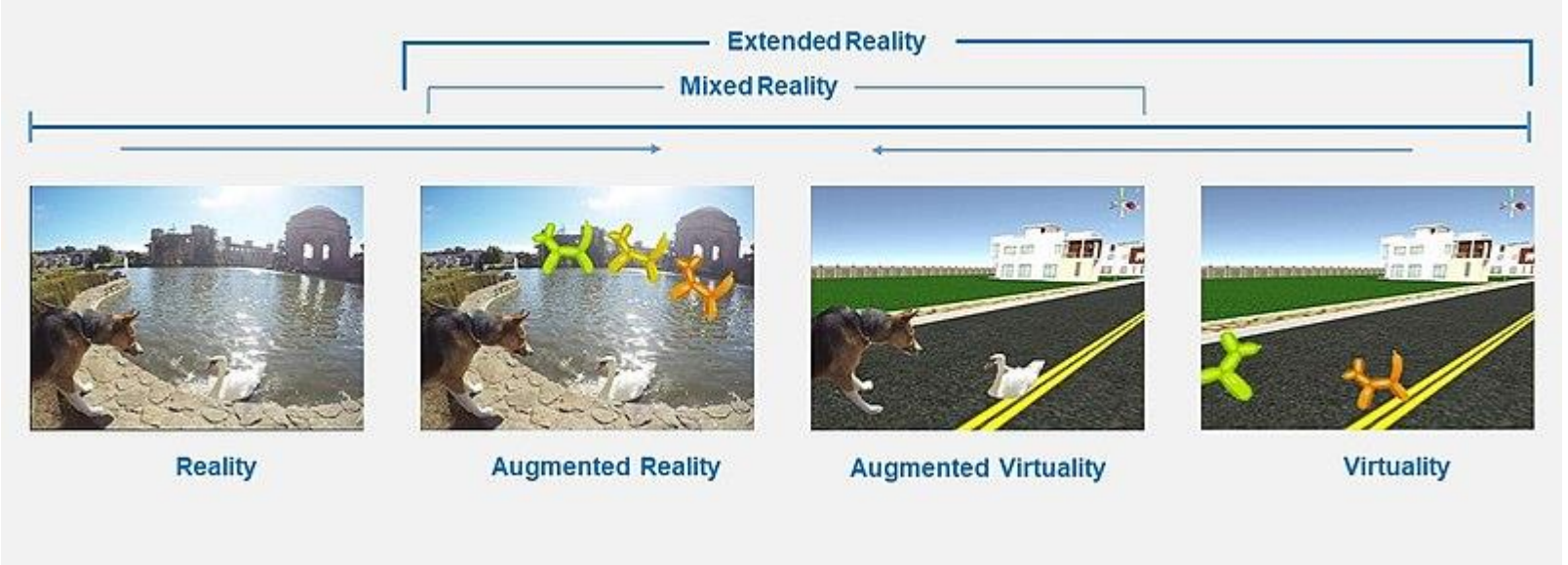
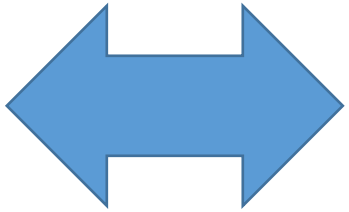
MR/VR/AR – What is it?



MR/VR/AR – What is it?

- In practice it’s just like a magic trick
  - We trick the user’s senses to create an illusion

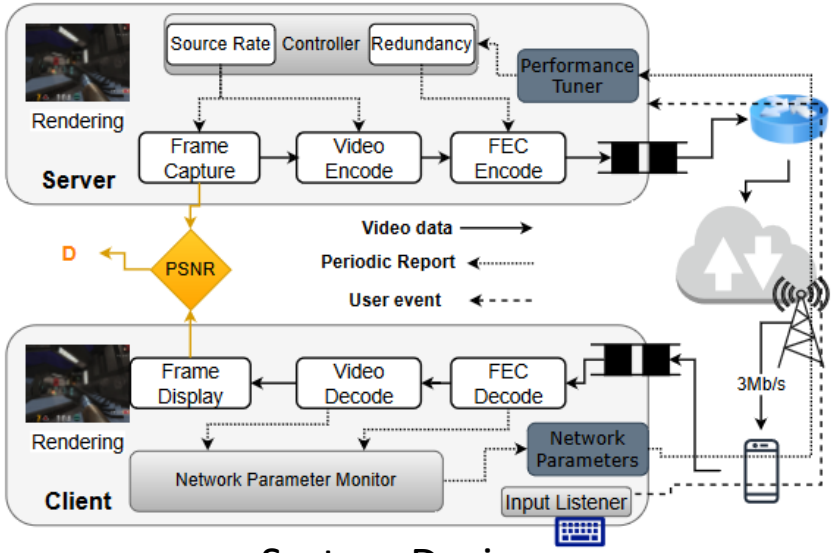


Joint Human-System Design

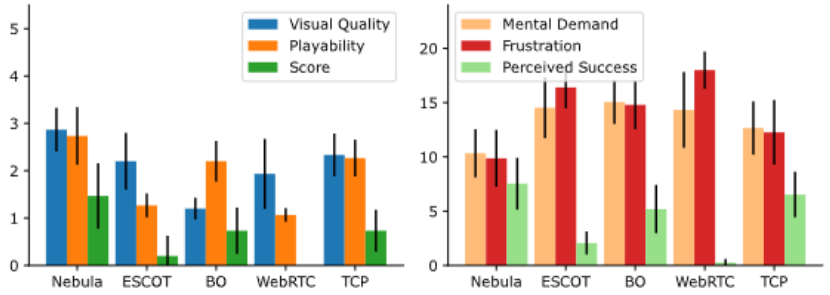
- Cloud Gaming: Game is rendered on a remote server and streamed through the network
  - Main objective: minimize end-to-end latency

- How?
  - Decrease visual quality?
  - Minimize latency?
  - Minimize jitter?
  - Maximize bandwidth utilization?

A little bit of everything



System Design

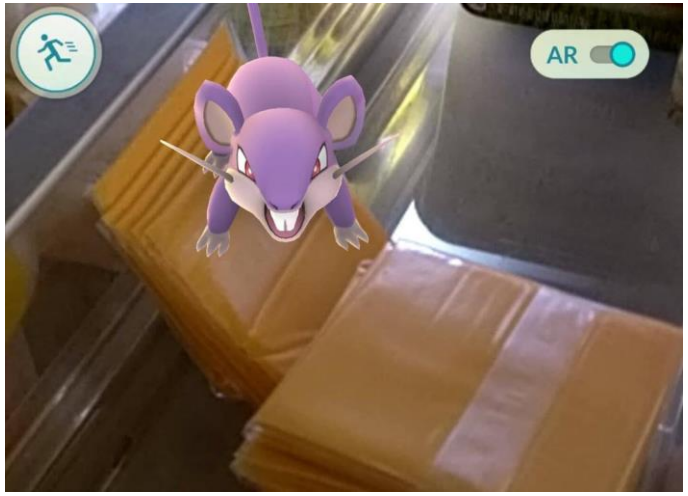


User Study

Alhilal, Ahmad, Tristan Braud, Bo Han, and Pan Hui. "Nebula: Reliable low-latency video transmission for mobile cloud gaming." In *Proceedings of the ACM Web Conference 2022*, pp. 3407-3417. 2022.

What about XR?

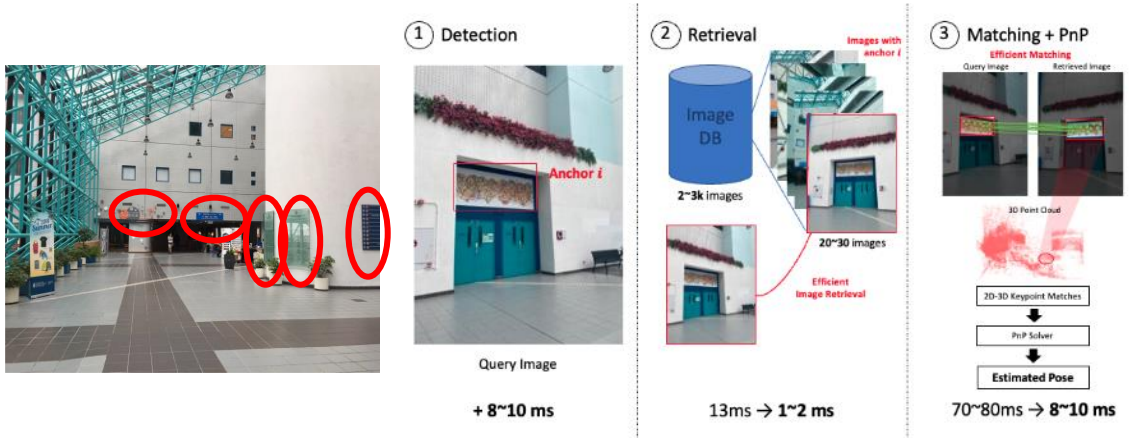
- XR is like a magic trick
  - The illusion is only maintained if we can fool the user
- System latency alone affects the user
  - Alignment issues
  - Motion sickness
- Many more parameters to consider
  - E.g., display refresh rate, graphic coherence
- You cannot design systems without considering the user



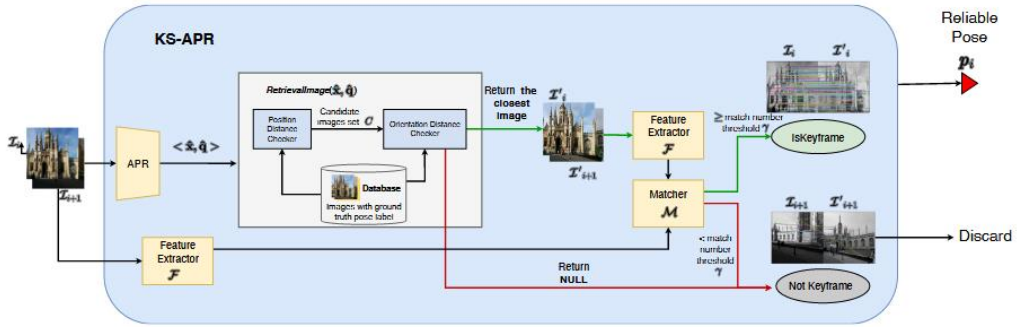
Braud, Tristan, Farshid Hassani Bijarbooneh, Dimitris Chatzopoulos, and Pan Hui. "Future networking challenges: The case of mobile augmented reality." In *2017 IEEE 37th International Conference on Distributed Computing Systems (ICDCS)*, pp. 1796-1807. IEEE, 2017.

Primary Areas of Interest

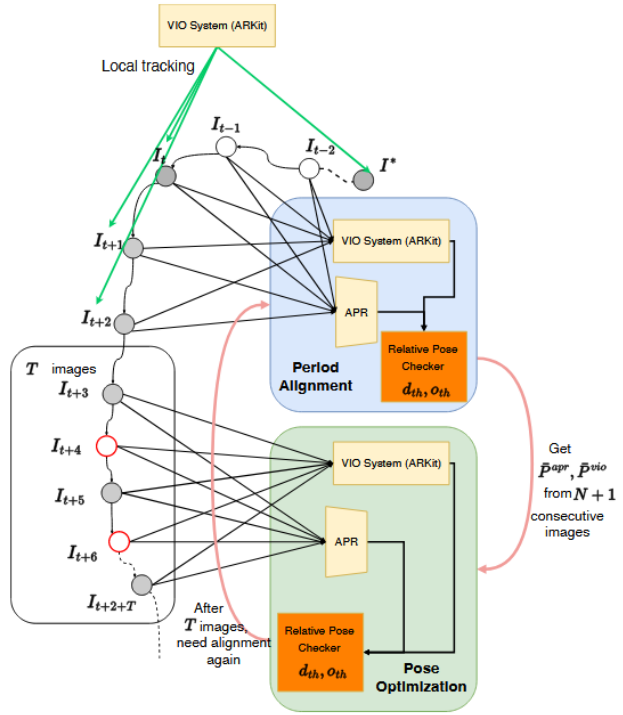
Visual Positioning in large Urban Environments



Visual Anchor Detection [1]



Pose Estimation Evaluation [2]



VIO-supplemented Absolute Pose Regression [3]

Semantic Anchor Positioning

[1] Chun Ho Park, Ahmand Alhilal, Tristan Braud, Pan Hui, "AnchorLoc: Large-scale, Real-Time Visual Localisation through Anchor Extraction and Detection" Accepted for Publication at IEEE International Conference on Pervasive Computing and Communications (PerCom), 2024.

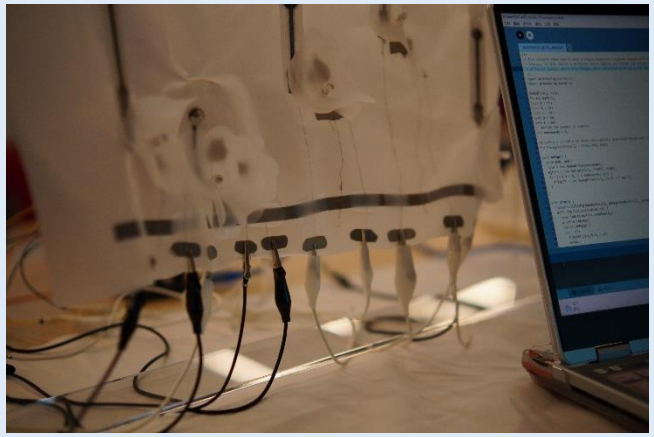
[2] Changkun Liu, Shuai Chen, Yukun Zhao, Huajian Huang, Victor Prisacariu and Tristan Braud, "HR-APR: APR-agnostic Framework with Uncertainty Estimation and Hierarchical Refinement for Camera Relocalisation", in 2024 IEEE International Conference on Robotics and Automation (ICRA), 2024

Digital Twins and Metaverse

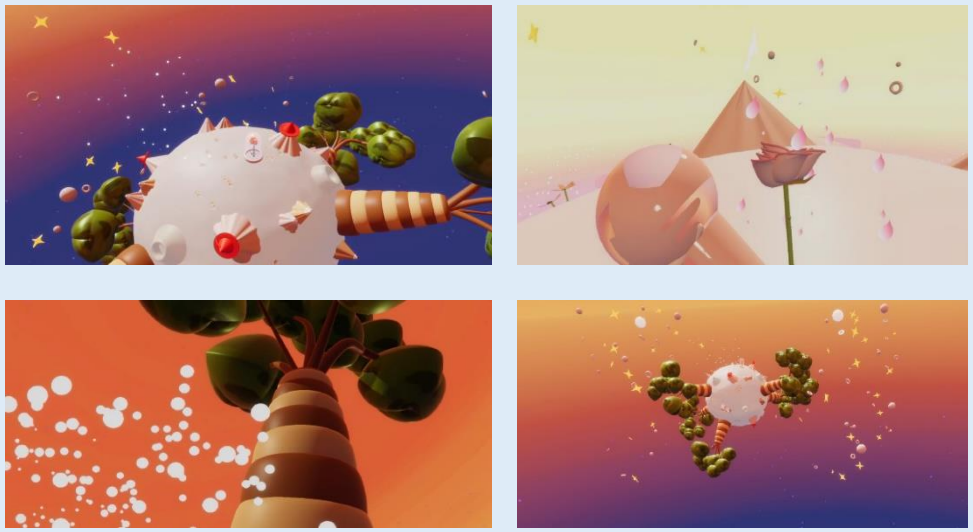
Metaverse Campus – HKUST HK & HKUST GZ

Digital Yin Tim Tsai – Tristan Braud, Christopher Chan, Salt and Light Preservation Centre – 2022

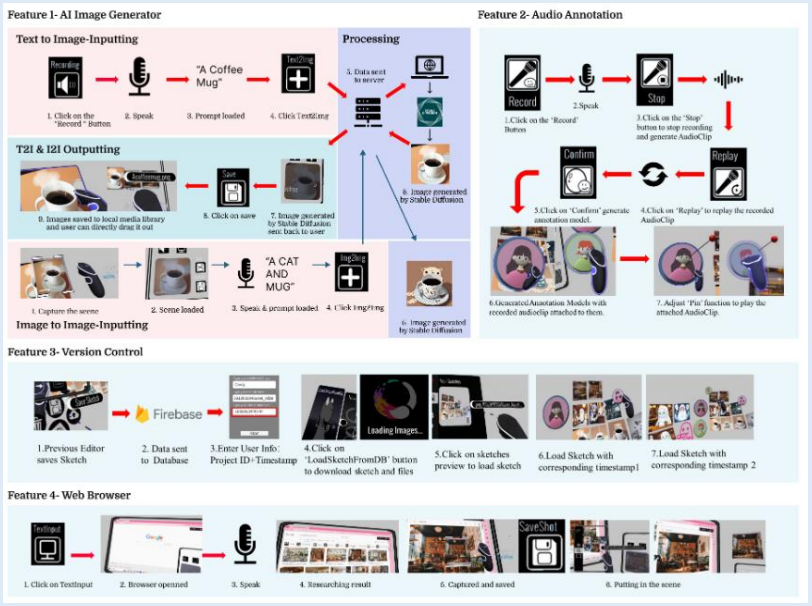
Design



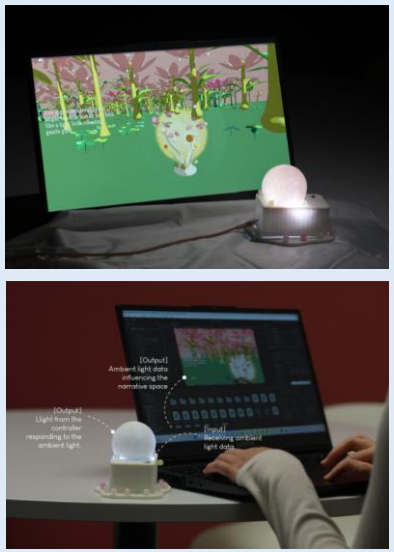
Material-Driven-Design,
“Unlogical Instrument”



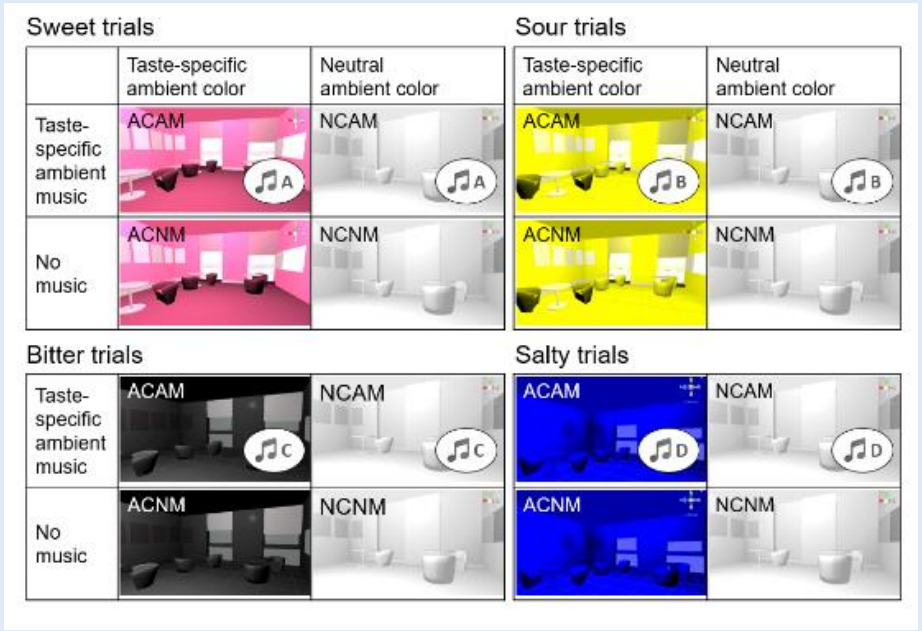
VR Sound Interaction Exploration



Collaborative Design Tools in VR

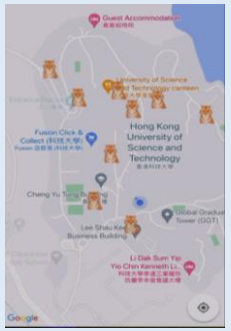


Multimodal
Generative Games



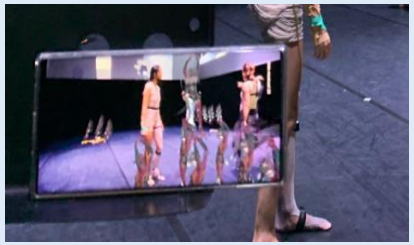
Synesthesia in VR

Art-Tech

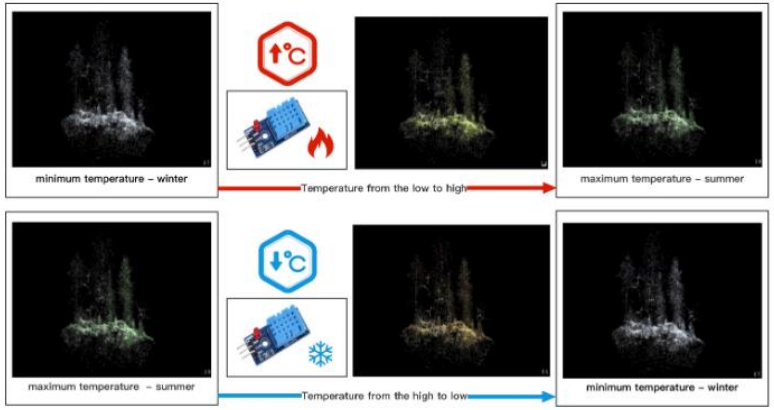




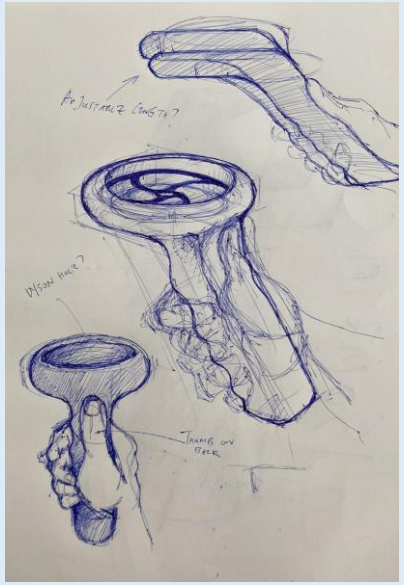
Tiger Hunt – Varvara & Mar (Varvara Guljajeva and Mar Canet Sola) ; AR Realisation: Yukun Zhao, Tristan Braud



Zelia ZZ Tan - Accelerating Dimension - 8-11 September 2022 – The Room, Freespace, West Kowloon Cultural District, Hong Kong
AR Realisation: Tristan Braud



Physical Sensing and VR artwork [1]




Haptic Feedback for VR 3D painting

[1] Yang, Simin, Ze Gao, Reza Hadi Mogavi, Pan Hui, and Tristan Braud. "Tangible Web: An Interactive Immersion Virtual Reality Creativity System that Travels Across Reality." In *Proceedings of the ACM Web Conference 2023*, pp. 3915-3922. 2023.

Ongoing Projects

TARANIS: A Hierarchical Framework for In-Vehicle City-Scale Augmented Reality Experiences

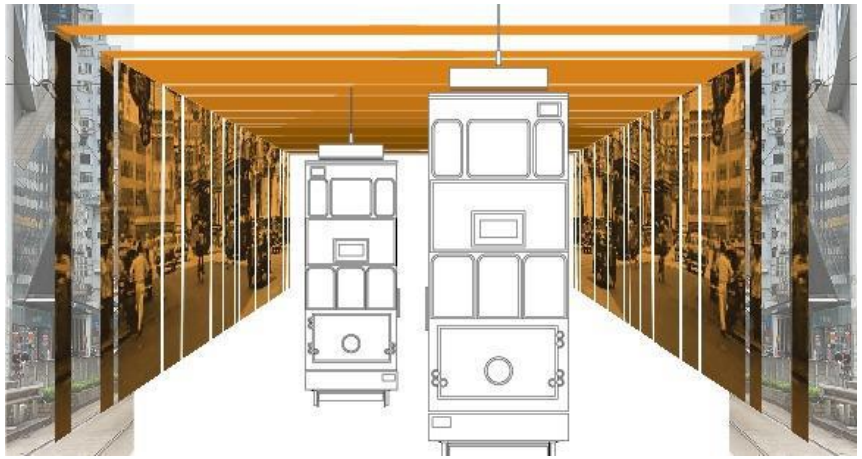
In-vehicle Visual Positioning for Augmented Reality

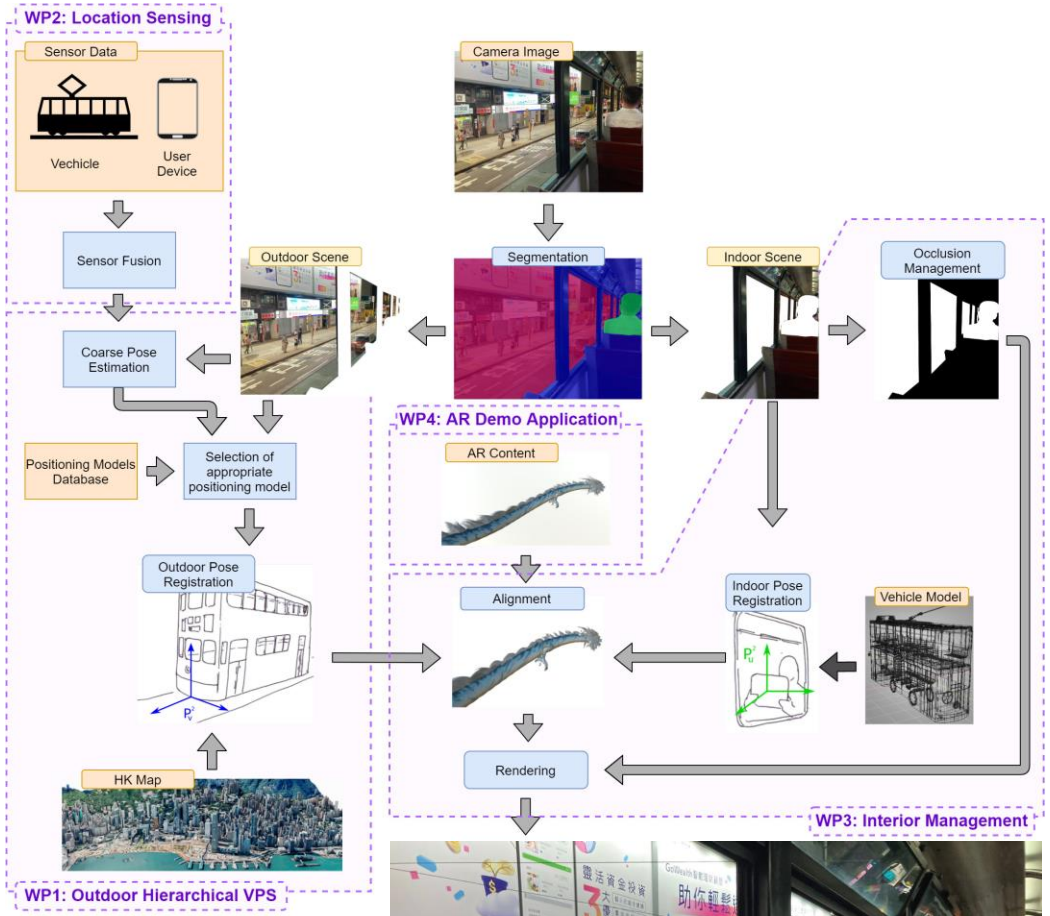
- *Enable city-scale experiences*
- *Accurate on-device positioning*
- *AR content inside and outside the vehicle*

Multi-disciplinary

- *AR systems*
- *Computer Vision*
- *Sensing*
- *Design*

香港電車
HK TRAMWAYS
EST. 1904

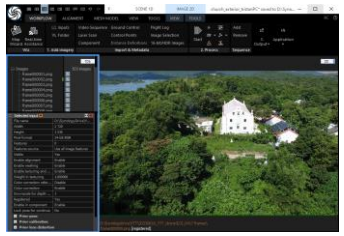




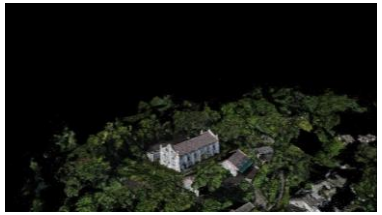
Augmented Model for Heritage Preservation

Capture

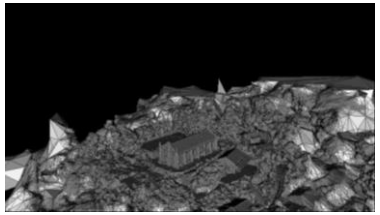
2D Images



2D Photogrammetry



3D Point Cloud

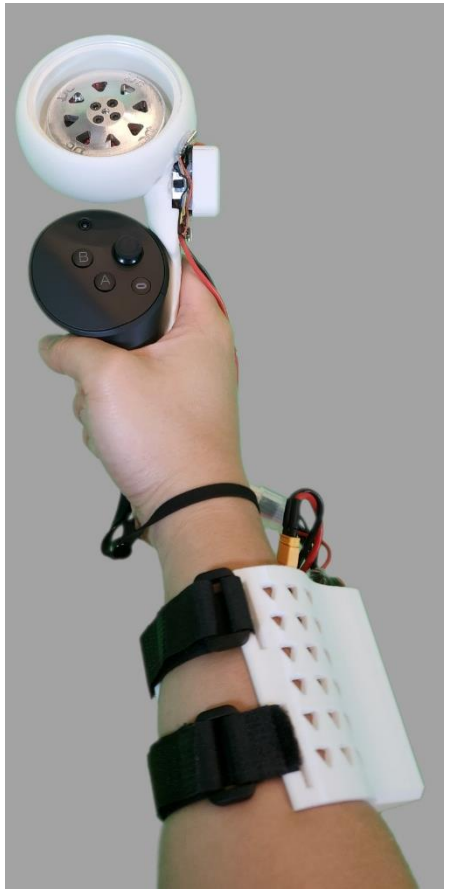


3D Mesh

(3D Textured Mesh)

Augmented Model

N:M+M – Nature: Metaphysics and Metaphor



Assisting Visually Impaired People

“Augmented Reality for the Visually Impaired”

Develop Environment understanding techniques to provide daily assistance:

- Mapping
- Navigation
- Object Localization
- Semantic Understanding
- Safety
- Transportation