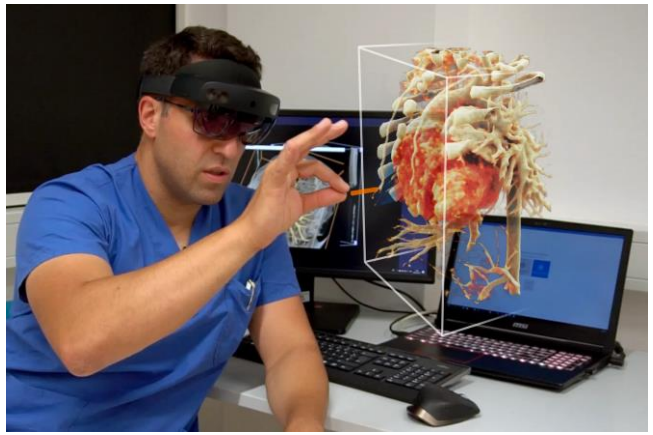
Multi-Platform Extended Reality (XR) Ecosystem for Diagnosis and Collaboration

Background – XR in 2021

- Medical images
  - Reconstructed to 3D with high resolution
  - Using the Microsoft HoloLens



Making the impossible possible: Meet the team who brought Cinematic Rendering to the HoloLens

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Background - Trend

- "XR devices have been applied to education, pre-procedural planning, and cardiac interventions"
- "The most readily available benefits of XR are in the form of visualizations of 3D anatomy and real-time display of anatomy and tooling."
- "There are currently no published prospective clinical trials using AR or XR in human subjects."

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Extended Reality in Medical Practice

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Abstract

Purpose of review: Advances in display technology and computing have led to new devices capable of overlaying digital information onto the physical world or incorporating aspects of the physical world into virtual scenes. These combinations of digital and physical environments are referred to as extended realities. Extended reality (XR) devices offer many advantages for medical applications including realistic 3D visualization and touch-free interfaces that can be used in sterile environments. This review introduces extended reality and describes how it can be applied to medical practice.

Recent findings: The 3D displays of extended reality devices are valuable in situations where spatial information such as patient anatomy and medical instrument position is important. Applications that take advantage of these 3D capabilities include teaching and pre-operative planning. The utility of extended reality during interventional procedures has been demonstrated with through 3D visualizations of patient anatomy, scar visualization, and real-time catheter tracking with touch-free software control.

Summary: Extended reality devices have been applied to education, pre-procedural planning, and cardiac interventions. These devices excel in settings where traditional devices are difficult to use, such as in the cardiac catheterization lab. New applications of extended reality in cardiology will continue to emerge as the technology improves.

Introduction

The rise of computing has transformed nearly every field, and medical practice is no exception. Despite the massive influence of computing on medicine, desktop computers and mobile devices are cumbersome or impossible to use in many aspects of clinical practice. Desktop and mobile devices rely on 2-dimensional (2D) screens to display graphics, text, and interface controls that users interact with using a keyboard and mouse or touch screen.

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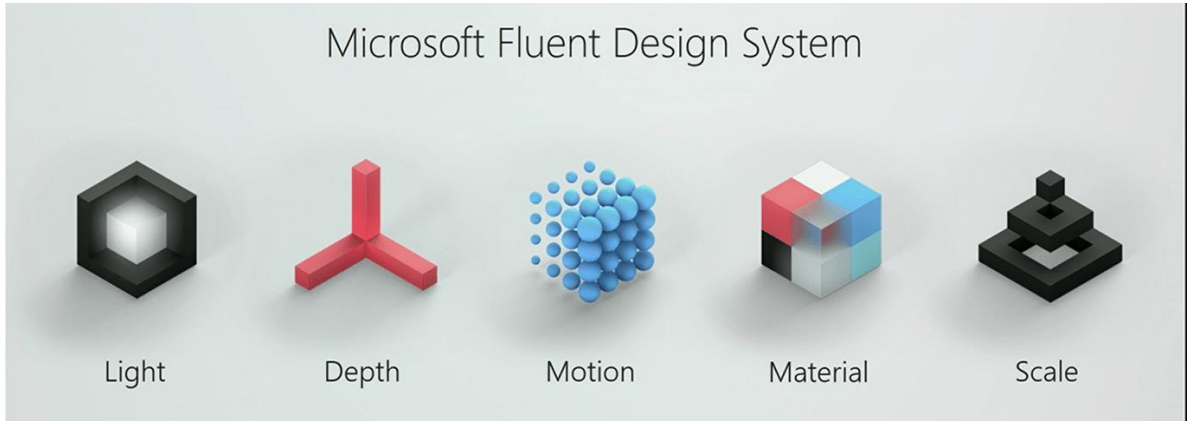
Background - Limitations

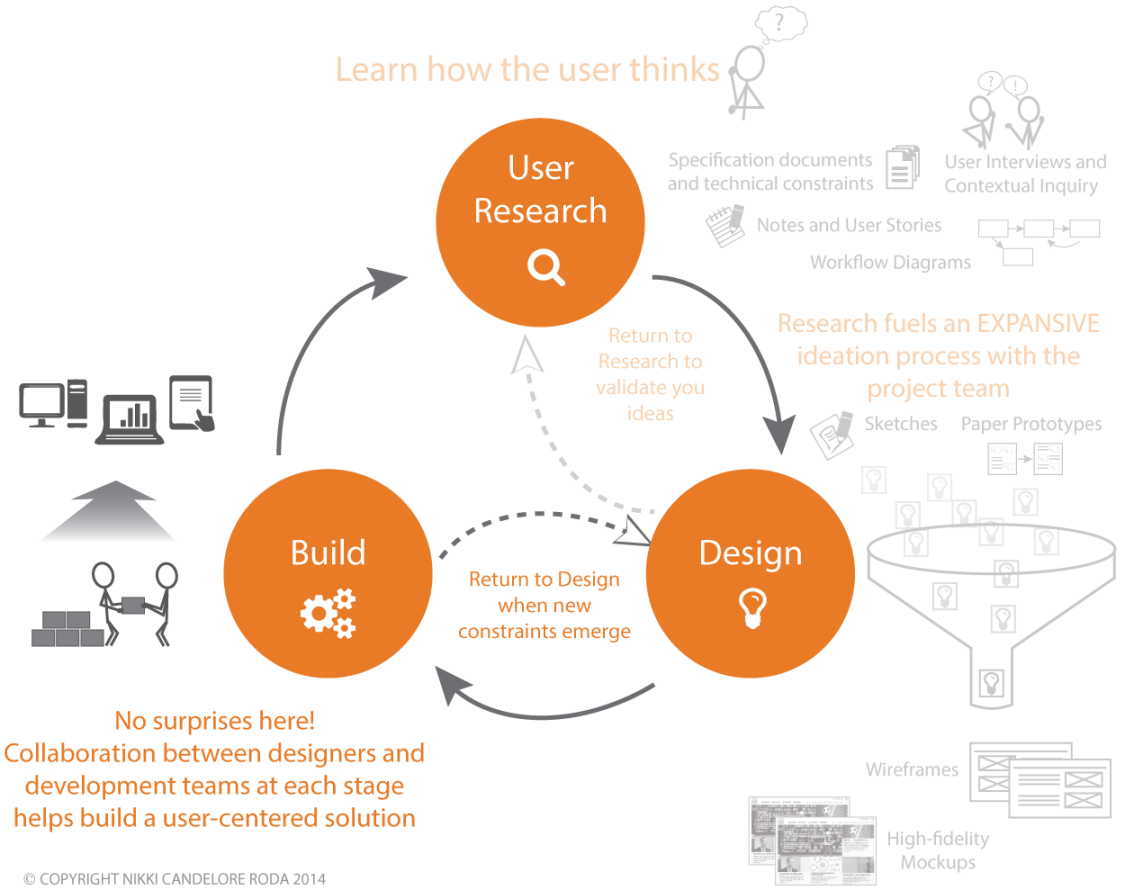
- Cost
  - Microsoft HoloLens 2: 20,000 - 40,000 RMB

- Poor user experience
  - 未成熟的UX Design framework
  - HMD (头显) 等设备的局限性
  - 3D素材的匮乏与高成本

→ Design Opportunities:
  - Low cost
  - High experience



Methodology – User Centered Design Approach



- Team up from 0 to 1
- Rapid prototyping in 48 hours
- A bit contribution to the health industry ☺

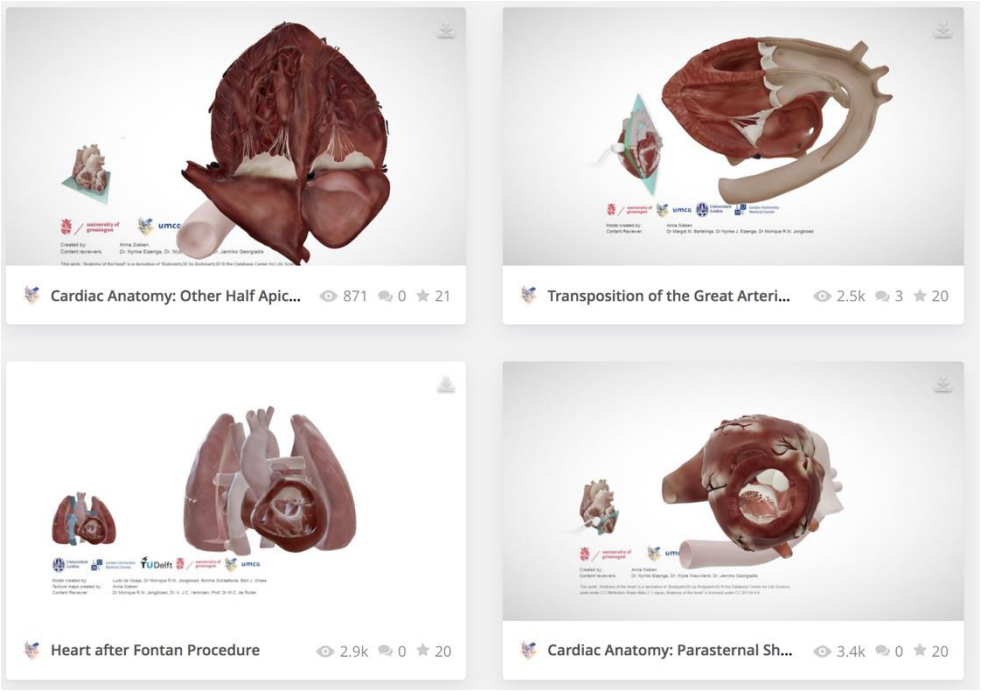
Methodology – User research

- 放射科, M.D. Candidate in XiangYa School of Medicine, CSU
  - 现状
    - 放射科的图像重建，横断位的基础上做出冠状位和矢状位，PC平面图像
    - 3D的图像更适合临床医生
    - 目前只有几个科室要求3D图像，比如骨科，且需额外加钱付费
  - 观点
    - 可使得心内科和外科医生在术前给患者及家属的讲解更通俗易懂
    - 分析作用有限，除非可以做到断面切片的可视化交互
  - 总结
    - 关心3D模型的质量与剖面，认为目前的工作站已经足够成熟
    - 对3D与XR的前景乐观，其潜在交互性有很大的提升可能性
- 临床, M.M. in Zhejiang University School of Medicine
  - 现状
    - 3D在医学上可应用在骨科、心血管科、神经内科
    - 心脏的CTA等都很成熟
  - 观点
    - 心脏瓣膜方向的XR有潜在价值，比如心脏内部的呈现，特别是心房与二尖瓣
  - 总结
    - XR技术可能让医生进一步完善术前评估，潜在价值

Methodology – Prototype & Demo

- Developed and empowered by XCode and Reality Composer with 3D model from UMCG

- Deployed on mobile devices and tablet (iPhone SE, iPhone 11, iPad)
- User scenarios
  - Remote / co-located
  - Presenter mode / self-explore mode
  - To-doctors / to-patients
- Interactions
  - Gesture
  - Edit
  - Tangible Anchor



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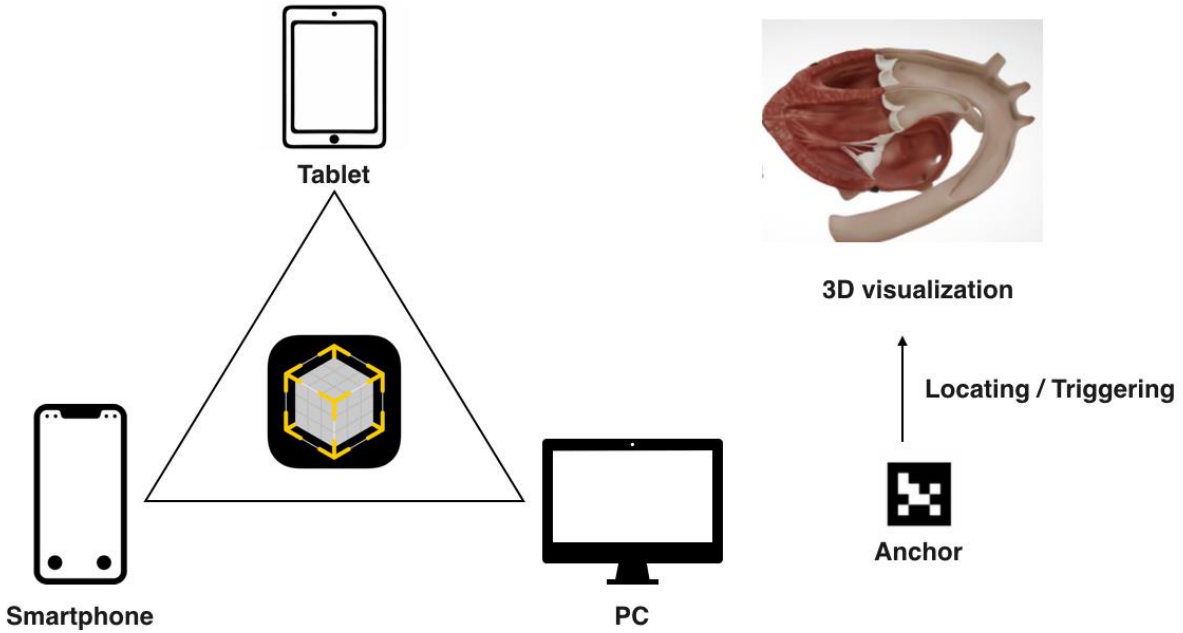

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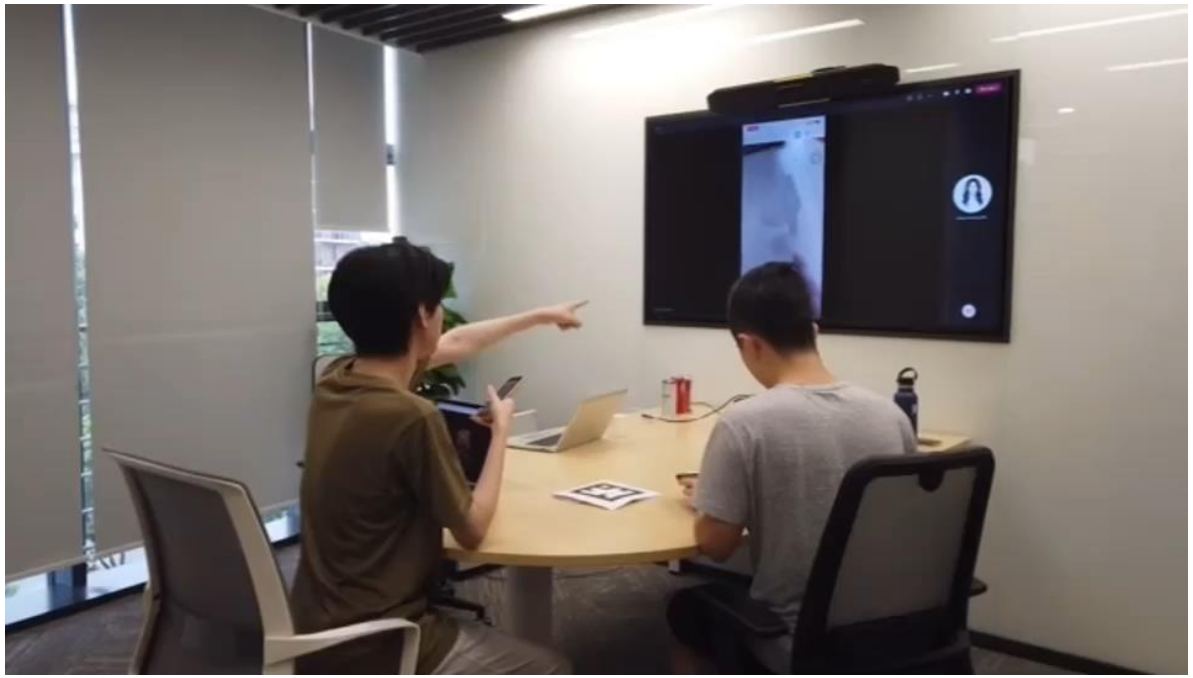
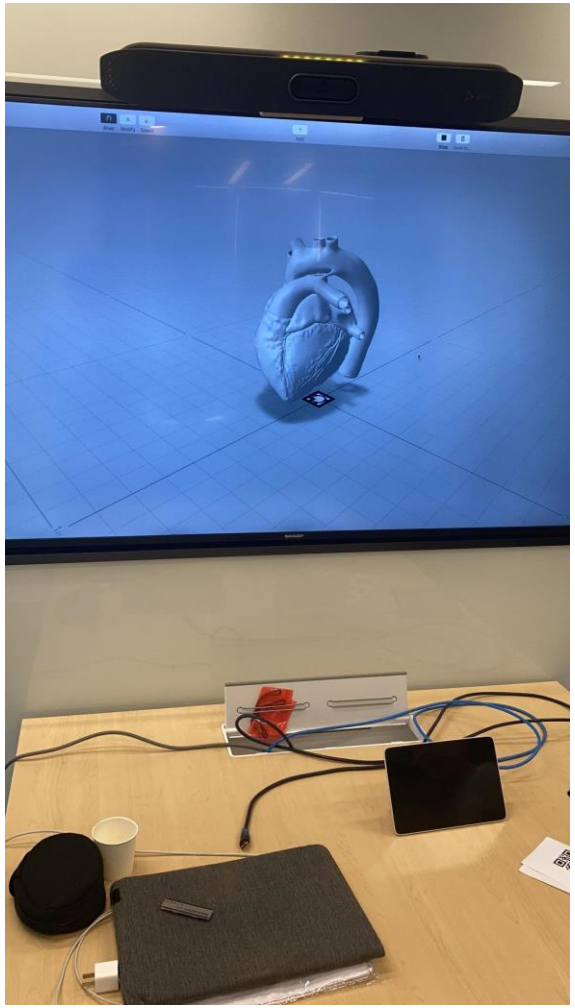
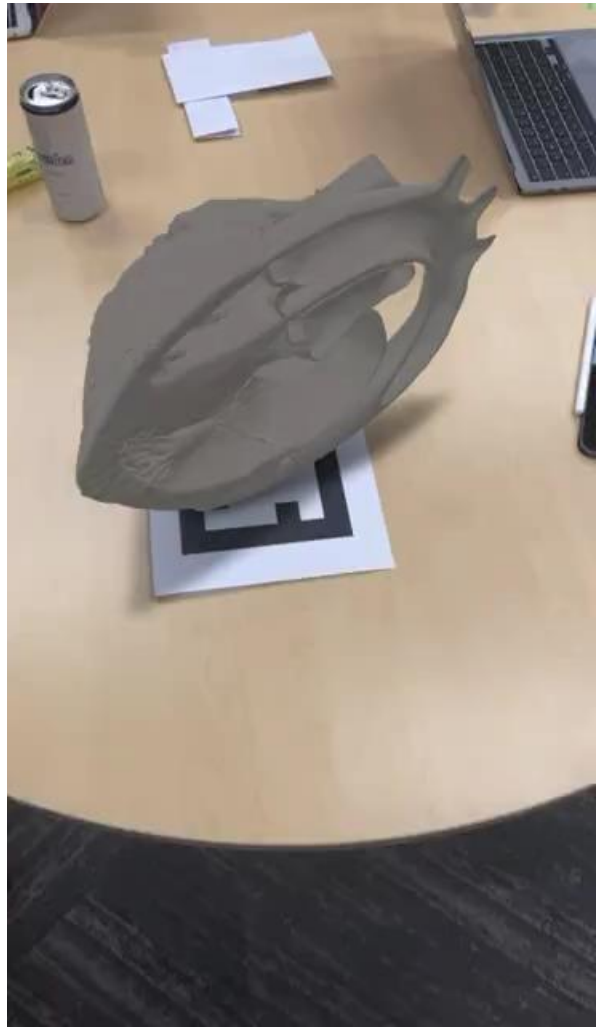


Methodology – Prototype & Demo



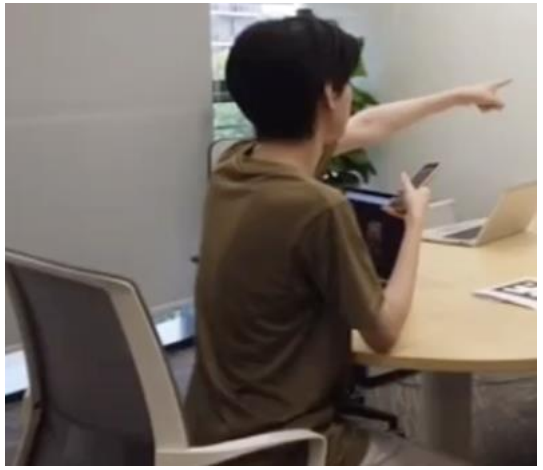
PC and Desktop



Mobile Without/with Anchor

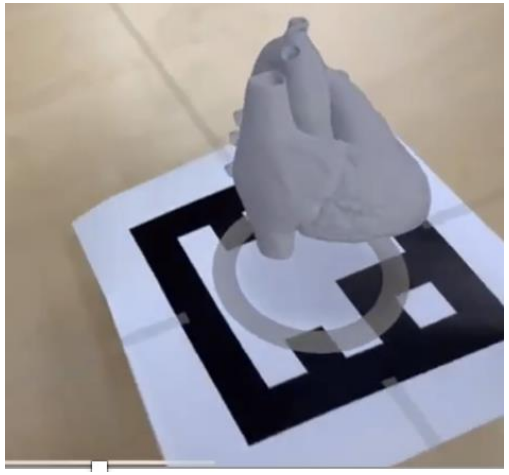
Methodology – Prototype & Demo

- Gesture



Pointing

Body leaning, screen sharing

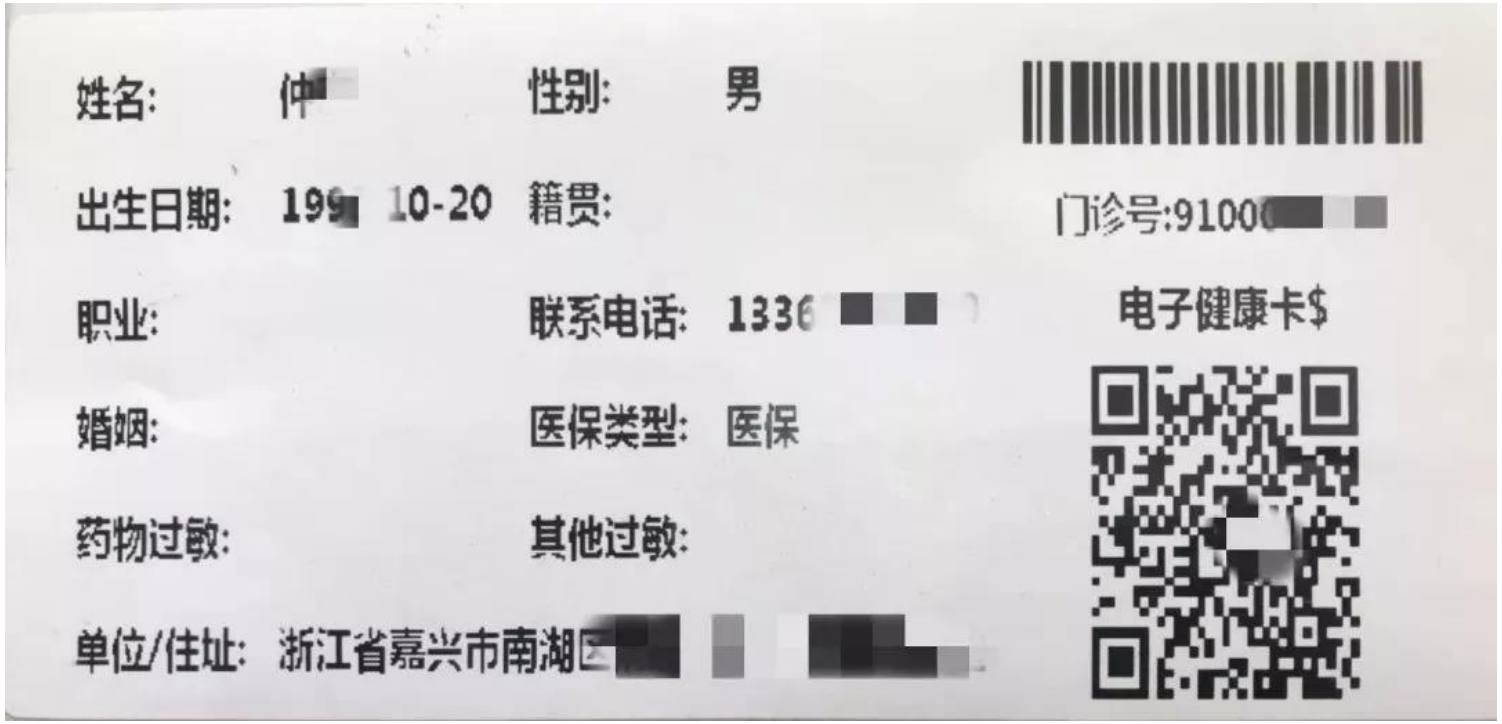


Dragging

Shifting

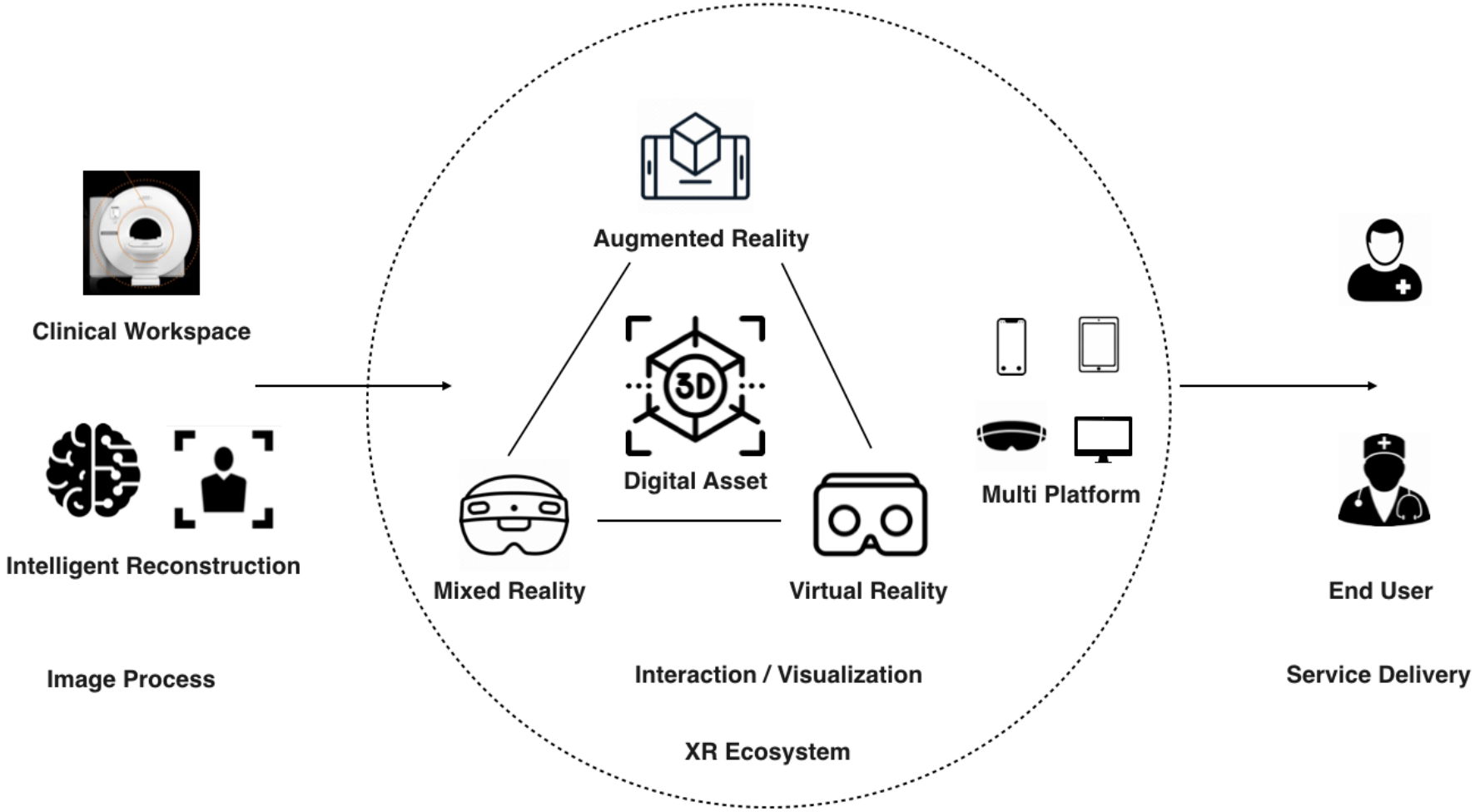
Methodology – Prototype & Demo

Tangible Interface



病历卡

Prospect



- XR Ecosystem for Diagnosis and Collaboration

Prospect

- Ecosystem of -> scan-recon-transformation -> application(XR)-> service delivery
- Establish the standards of digital assets for industry
- Cultivate the customers ideology for diagnose and medical image processing