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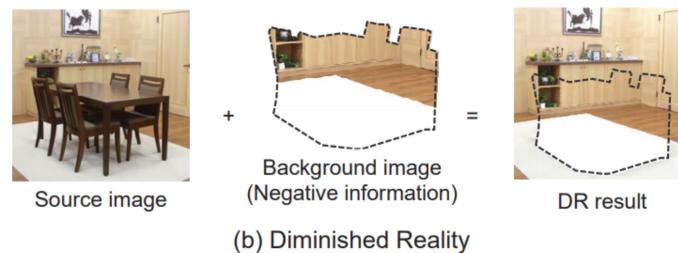
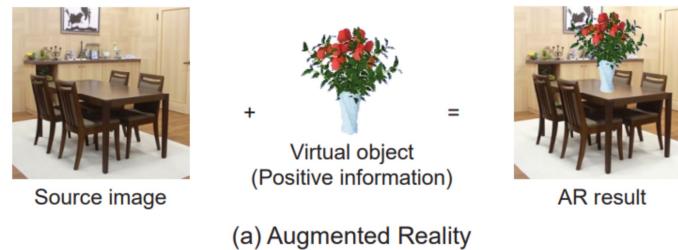
The Visualisation of Internal Objects through Diminished Reality Techniques

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14th April 2021

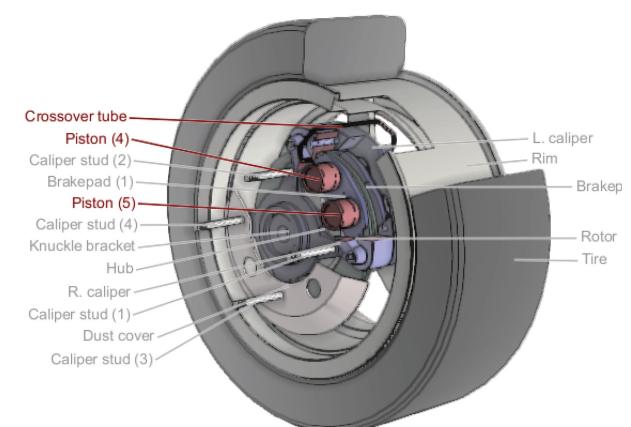
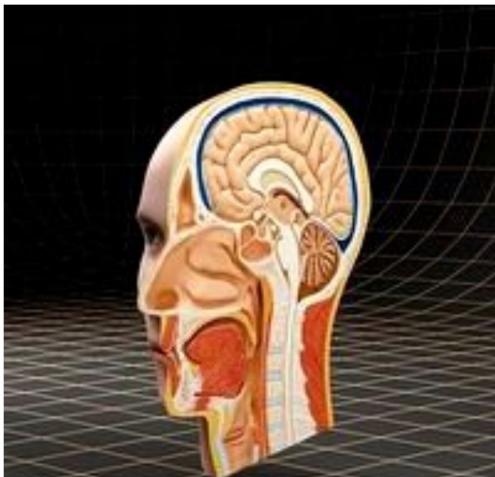
What is Diminished Reality?

- Diminished Reality:
 - Opposite of Augmented Reality.
 - Visually removing a real object from the real world.



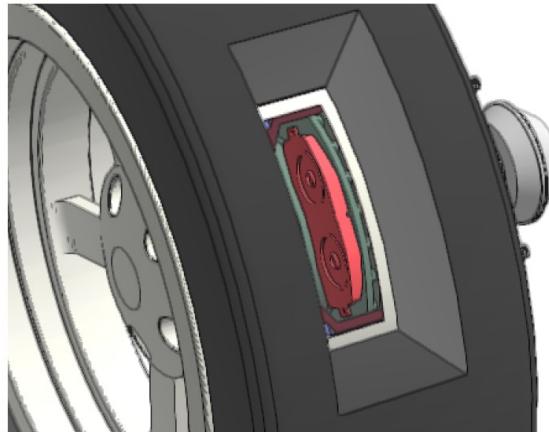
Cutaway Visualisation

- Widely used technique in visualisation.
- Creates depth to object position.
- Many applications...



Background & Related Work

- Inspired by “Interactive Cutaway Illustrations of Complex 3D Models” – Wilmot Li et al, 2007
 - Cutaway
 - Transparency – Alpha blending



Background & Related Work

Continued...

- Cutaways...
 - Reduce occlusions of tightly connected parts.
 - Expose important parts.
- Transparency...
 - Reveals true complexity of object internals.
 - Extremely difficult to distinguish the layering relationships between the transparent parts.

Technologies Used

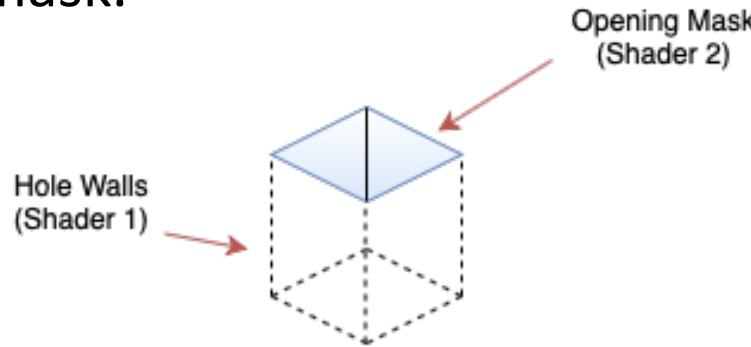
- Unity
- Xcode
- Blender
- Vuforia library
- Open Cascade



Design

How are the holes made?

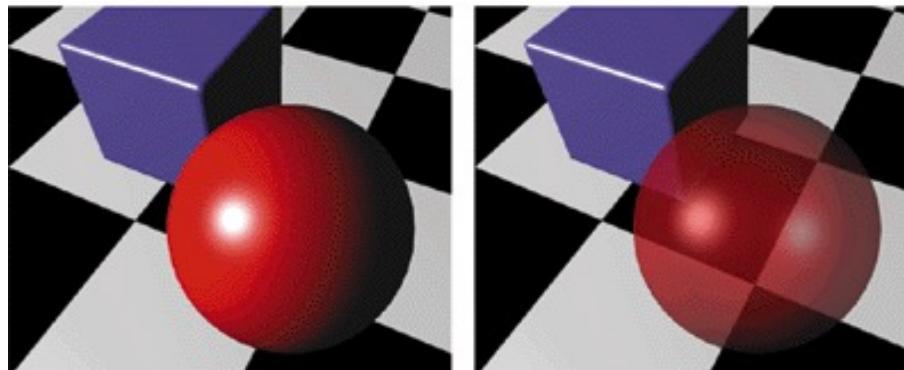
- Magic of shaders in Unity!
- Works using 2 shaders
 - Shader 1 applied to the hole and internal parts.
 - Shader 2 applied to flat mask covering the opening of the hole.
- Hole and internal parts can only be seen when looking through the mask.



Design

Alpha Blending

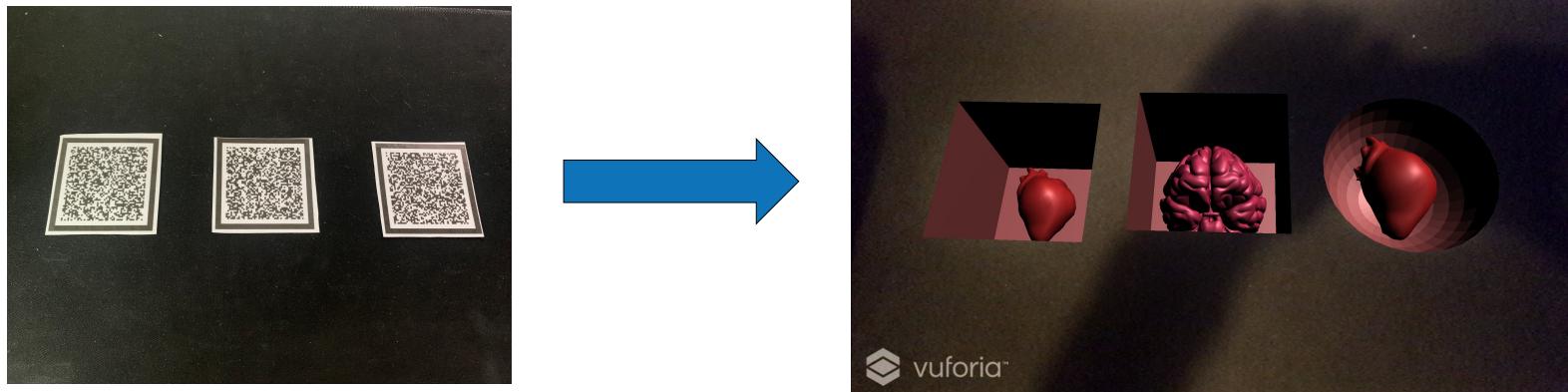
- Used to implement transparency.
- Object's alpha value is changed to become more "see-through".



Design

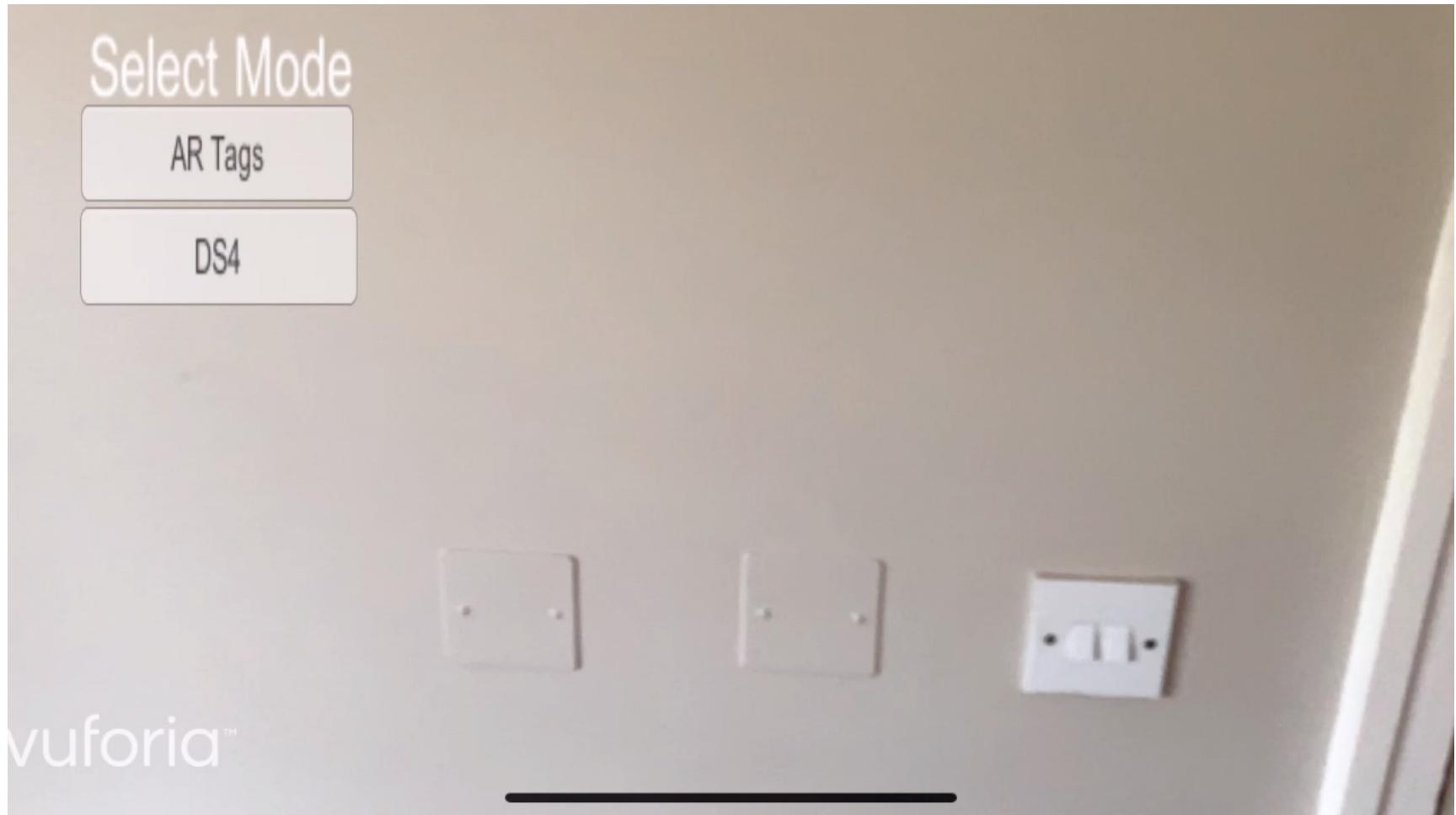
Application Concept

- Began with medical concept
 - Planned on displaying organs on human dummy.
 - Used AR tag tracking to display holes using Unity App deployed on Android device.



- Evolved to engineering/hardware concept
 - Using model tracking to place holes.

Demo of Project



Without Cutaway or Transparency...



Implementation Issues

- Difficult to display holes on non-flat surfaces.
 - E.g. PS4 controller D-Pad and Buttons
- Relies on device's camera quality and graphical capabilities.
 - Switched from Samsung Galaxy S6 to iPhone XR to improve performance.
- Relies on lighting.
- Lack of research in area.
- Never used Unity before.

Evaluation

- Cutaway technique is visually effective for learning and understanding object's dimensions and parts.
 - However, difficult to implement.
- Transparency is easier to implement and can be effective when...
 - Not many intertwined parts.
 - Focus on one part is not required.
- Vuforia model tracking performs well...
 - When all conditions are met (lighting, camera, graphics etc...)

Conclusions

- Bright future for the world of Diminished Reality!
- Became quite proficient in using Unity...
 - Learned more about shaders and how to code in C#
- Learned importance of time management working alone.
- Overall a very enjoyable project!



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Questions ?



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Thank You