Integrating Virtual Reality During the Architectural Design Process:
a Survey to Identify Practitioner Needs

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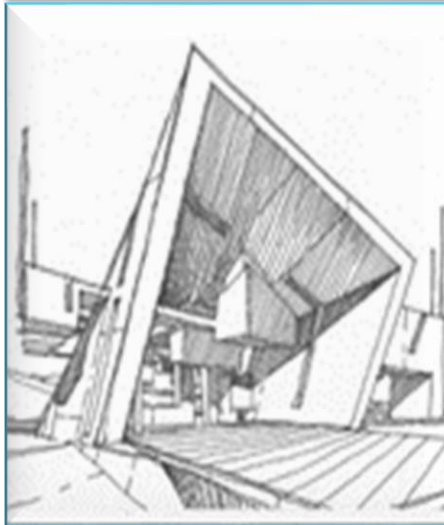
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Evolution of Architectural Design

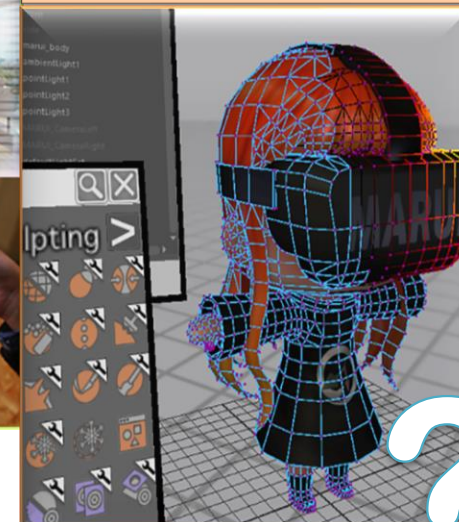Paper drawings & scale models

2D/3D modelling (WIMP interfaces)
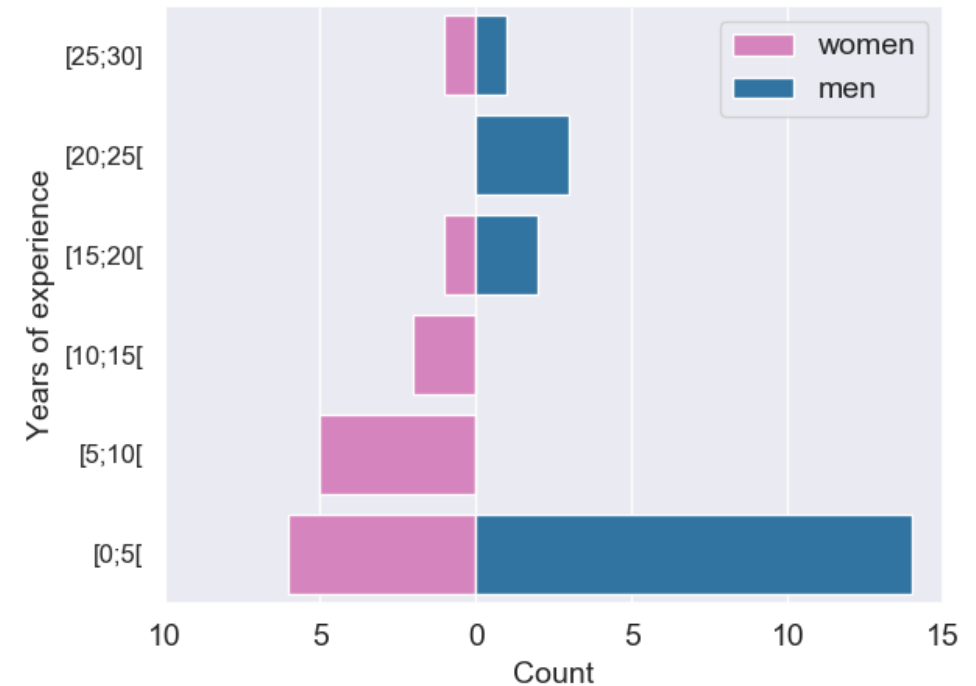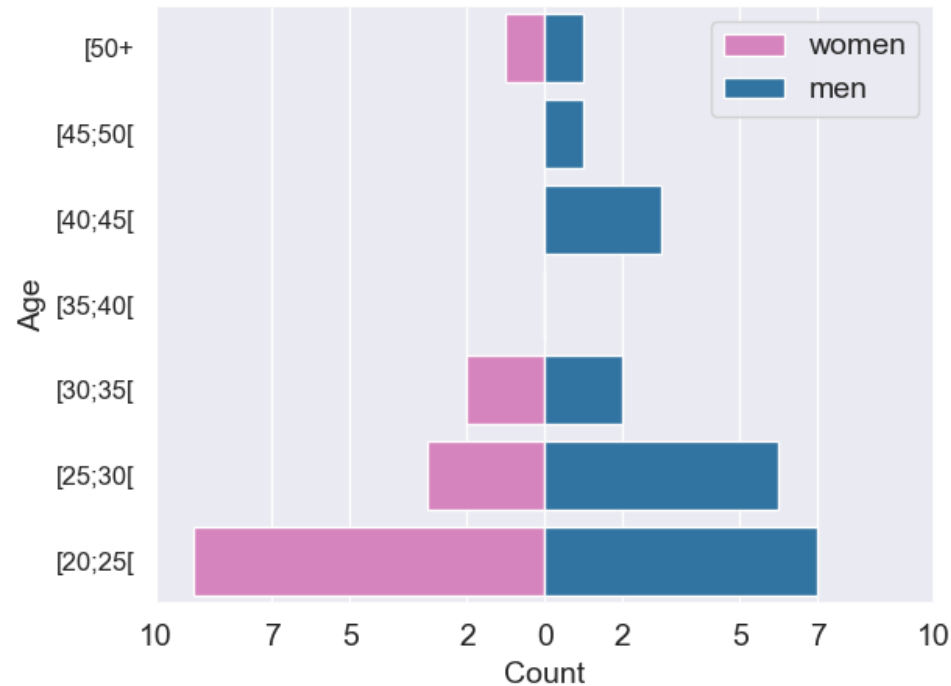
AR/VR visualisation

AR/VR modelling

Contents

- Survey to evaluate architects' opinion
  - Online questionnaire in French and English
  - Various profiles
    - Practitioners (Rhinoceros fora)
    - Researchers (eCAADe Facebook and LinkedIn pages)
    - Students (3 French-speaking universities)
  - 36 complete responses

- A few pointers to existing work

Population
(Age)

→ Quite young population

- 69% between 20 and 29 years

- Median: 25; IQR: 9.25

Population
(Architectural Profile)

Architectural profile	Description
Expert (12 respondents)	Bachelor's degree + 10y of XP OR Master's Degree + 5y of XP OR PhD
Competent (11 respondents)	Bachelor's degree +1y of XP OR Master's degree
Novice (11 respondents)	Bachelor student OR no (ongoing) diploma but a bit of XP
Uninitiated (2 respondents)	None of the above (=no background)

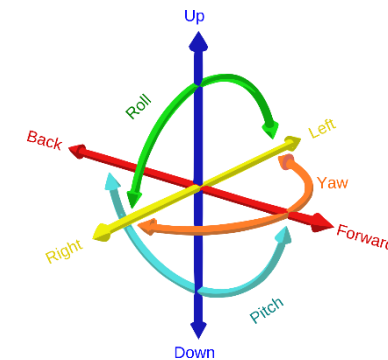→ Balanced grouping wrt. to architectural experience

Population
(VR Profile)
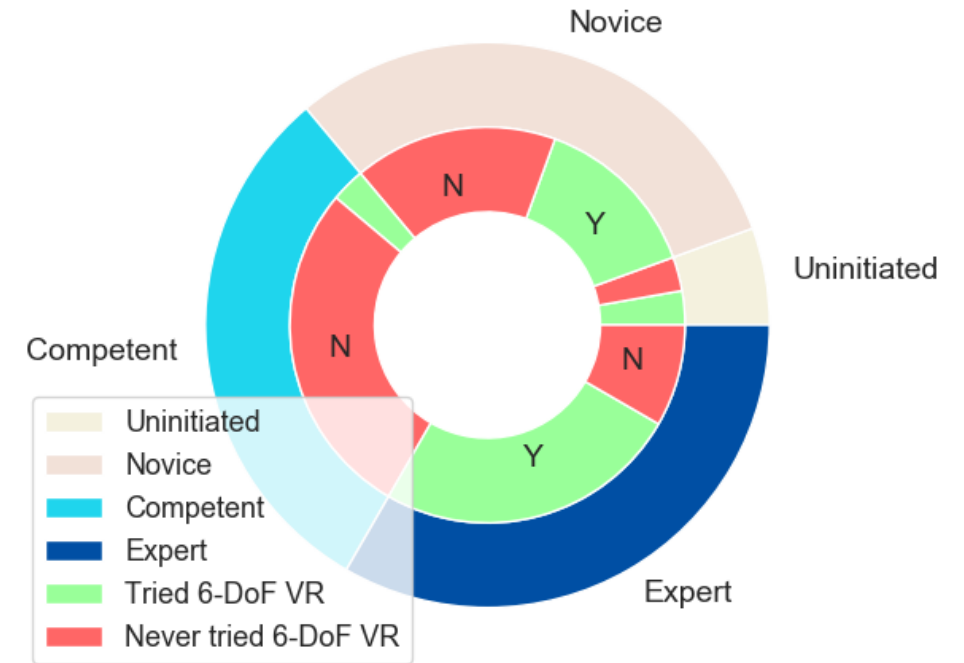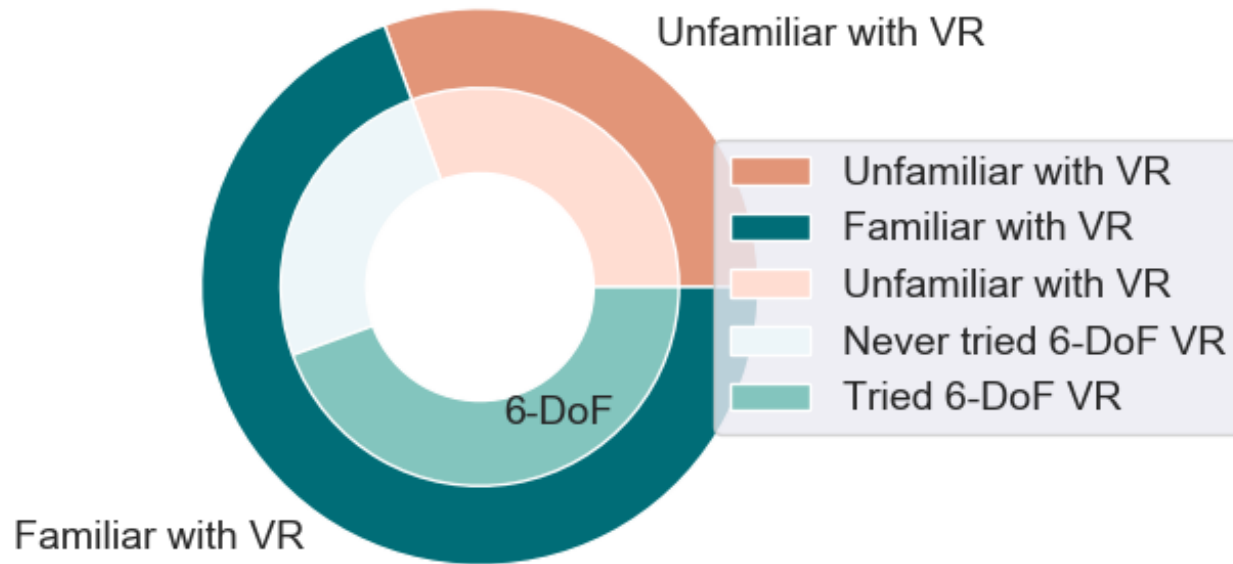
→ Most had tried VR

→ But not necessarily 6-DoF devices/experiences
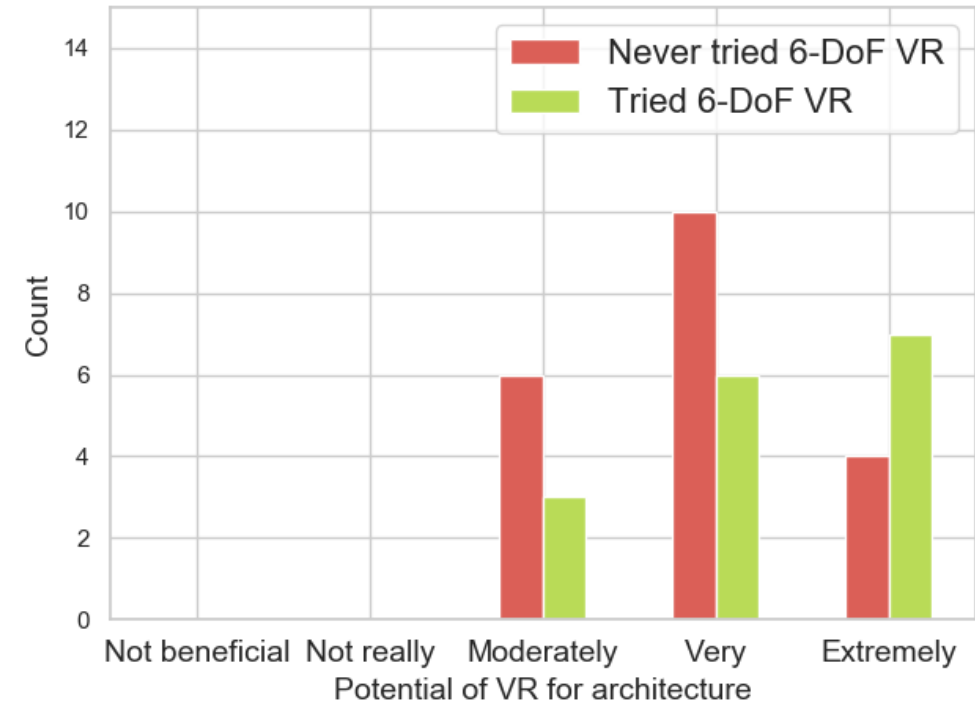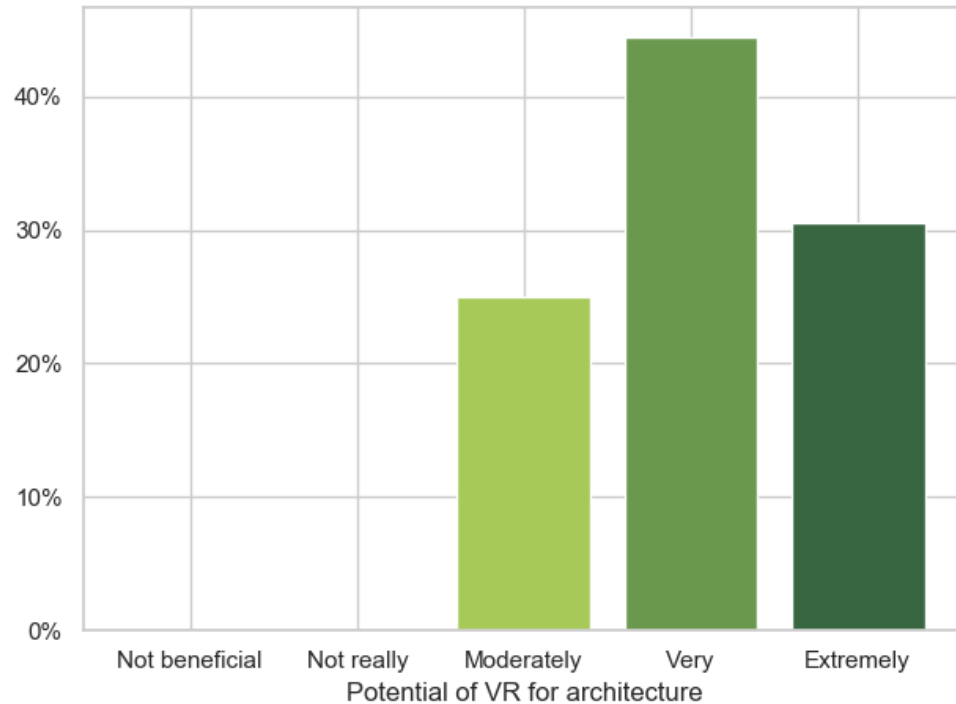
VR for Architectural Design
(Current use)

- 11 out of the 21 that tried VR had also done so for architecture
- Half (6) of them only mentioned Unity
  - Can be easier
- Tooling complexity
  - R18: *"work-intensive transition from regular CAD model to VR"*
  - R17: *"difficult to set a proper scale for the imagery"*
- Perfectible interface
  - R27: *"lack of easy-to use interface"*
  - R56: *"limited interactions"*
- Collaboration
  - R27: *"it gets kind of lonely in VR"*
  - *"on projects with multiple stakeholders, it takes a long time to 'present', because everybody wants to 'go in' "*
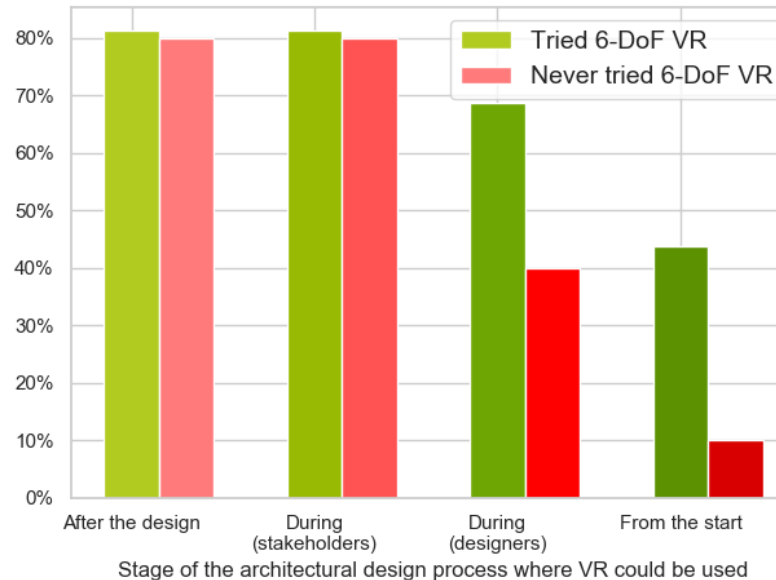
VR for Architectural Design
(Potential)

- All respondents were at least moderately convinced by VR's potential
- 75% consider it could be very or extremely beneficial

VR for Architectural Design
(Potential)

- VR suitable for presenting a finished project (29/36)

- To involve stakeholders during the design process (29/36), even for the designer (19/36)

- Some even consider VR tools could replace desktop-based software (9/36)

- Prior experience with 6-DoF VR → More inclined to see its potential

VR for Architectural Design
(Existing work)

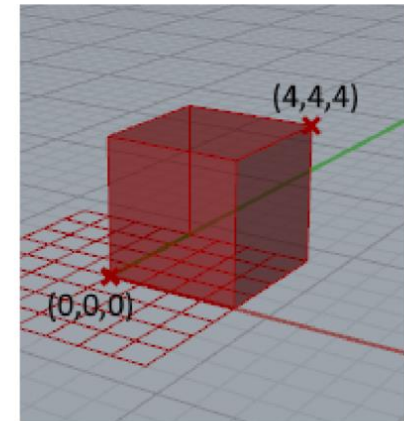

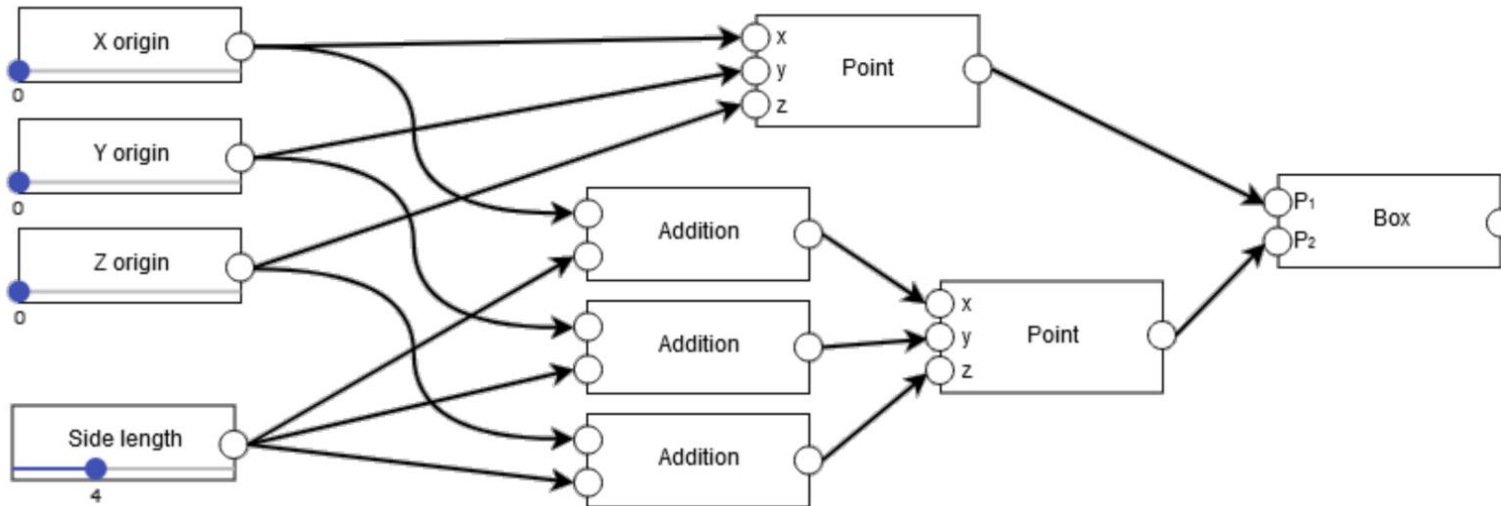(Hyve-3d, DOI:10.1177/147807116638921)
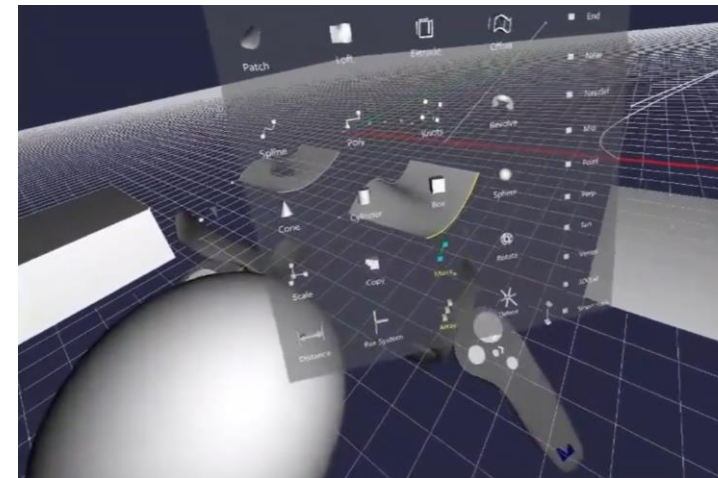
Mindesk

Algorithmic Design
(Parametric modelling & Grasshopper)

- Popular computational design tool (especially in research)
- Generates designs from "algorithms"
  - whose structure reflects the design logic
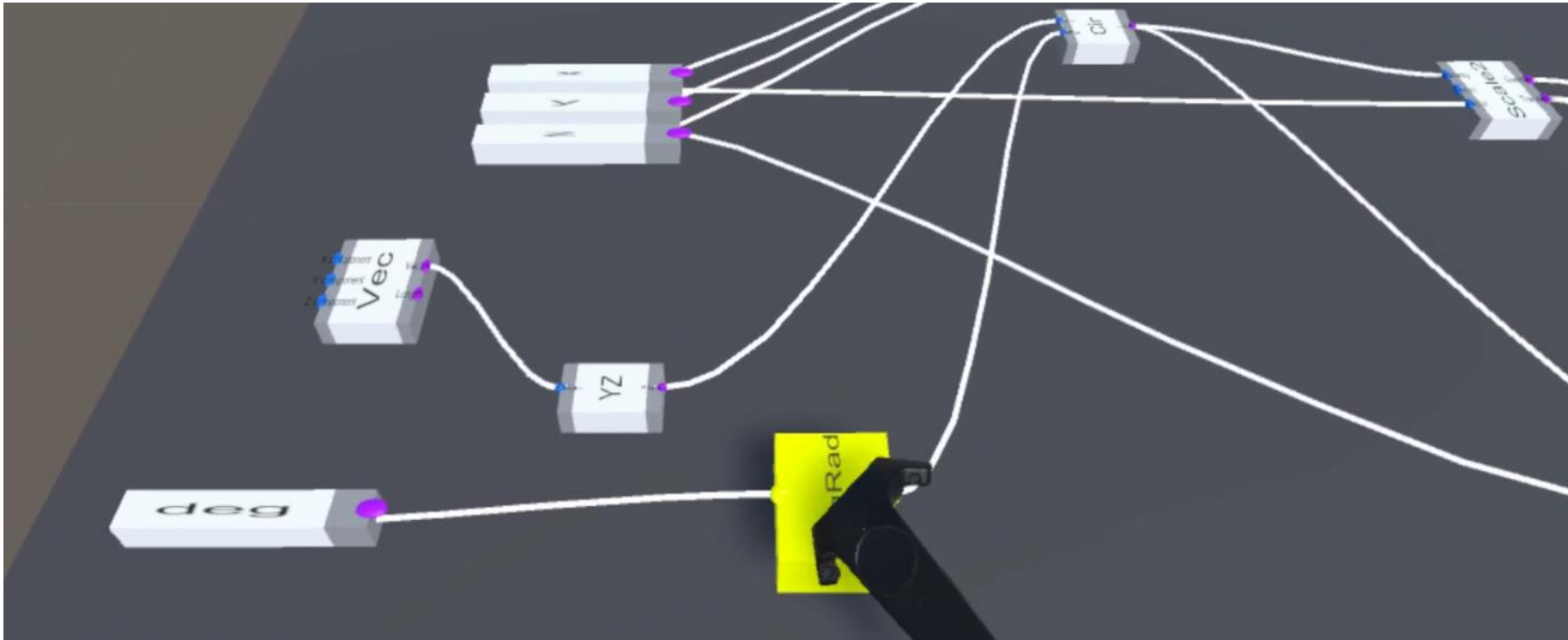 - whose parameters can be adjusted

➡ More complex (real) example:
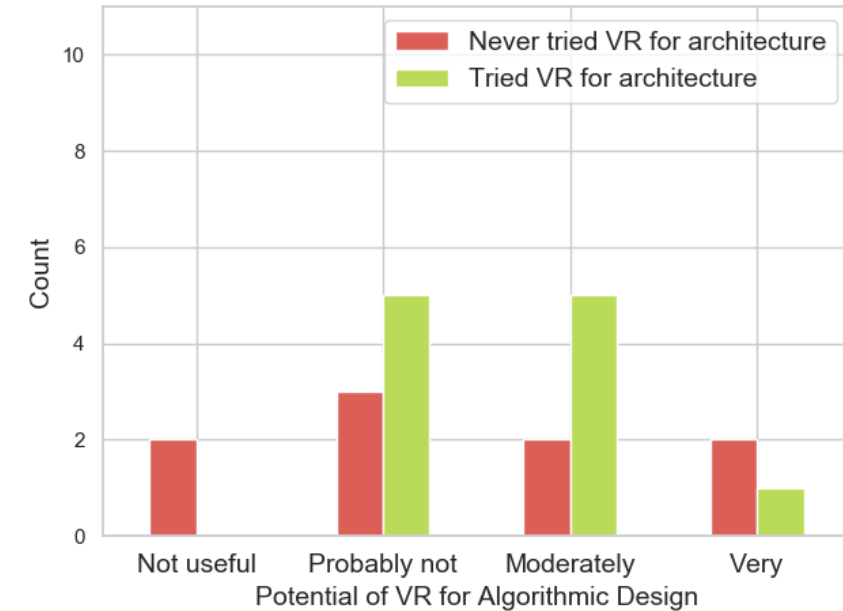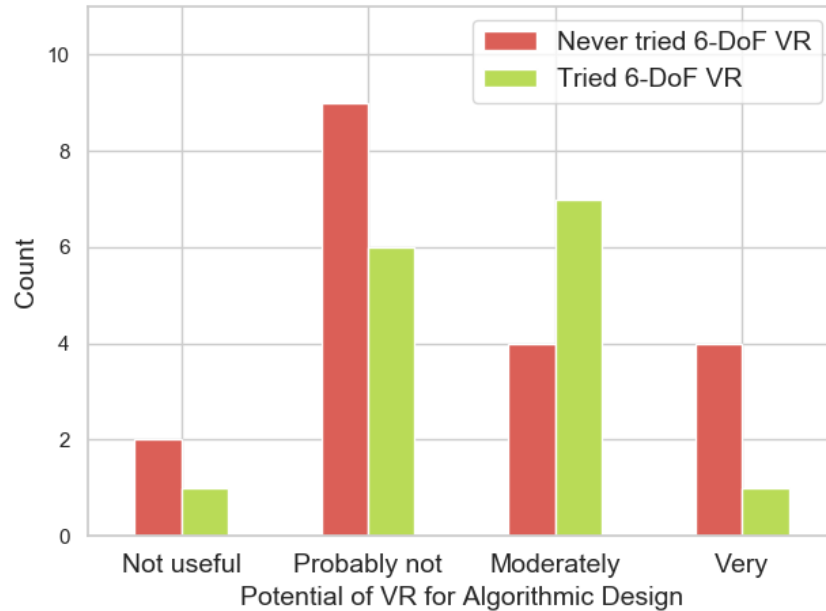https://www.youtube.com/watch?v=bKpBGcNSyUc

Algorithmic Design
(VR prototype)

- Does not intend to provide a consumer-grade experience

- VR demo shown on a 2D video

- Previous prototype [arXiv:2001.00892]
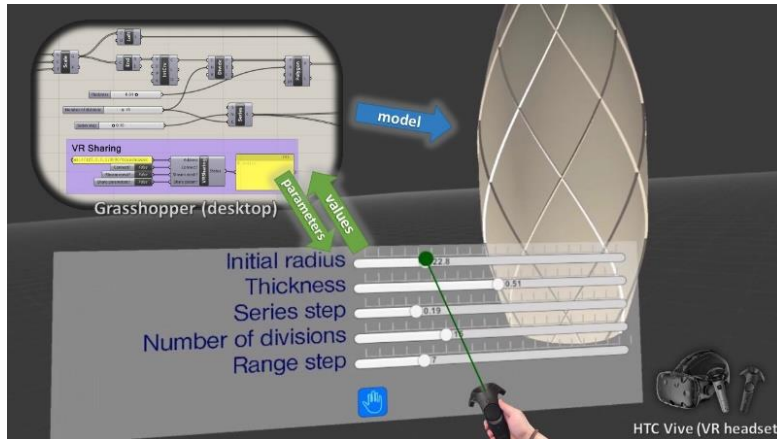
Algorithmic Design
(Usefulness)

- Mixed results but some perceived interest
- Parameter value adjustment only
- Need visualisation of the rendered geometry
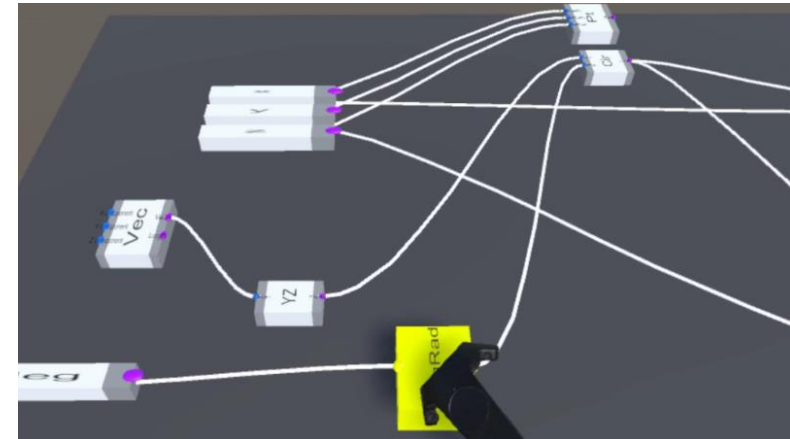- Dimensionality mismatch but unavoidable?
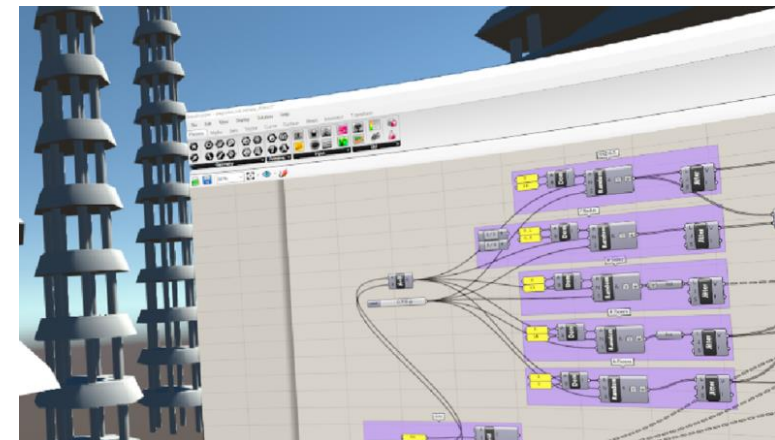
Algorithmic Design
(Existing work)

(eCAADe 2018, arXiv:1906.05532)

(eNTERFACE 2019, arXiv:2001.00892)

(to be published)

(Castelo-Branco et al. 2020,
DOI:10.1177/1478077120958164)

Discussion

- Main threats to validity
    - Population size
    - Selection bias (towards Grasshopper)
    - Student-heavy
    - For the second part on AD: 2D video vs VR

- Perspectives
    - More natural and adapted interaction
    - Better visualisations (VR, AR, realistic renderings, surroundings, etc.)
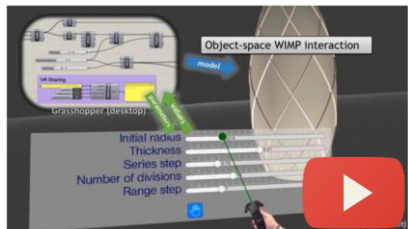   - Support for collaboration (co-located, distant)
    - …

References

- Castelo-Branco, R., Brás, C., and Leitão, A. M. (2020). Inside the matrix: Immersive live coding for architectural design. *International Journal of Architectural Computing.* DOI:10.1177/1478077120958164

- Coppens, A., Bicer, B., Yilmaz, N., and Aras, S. (2019). Exploration of interaction techniques for graph-based modelling in virtual reality. In *eNTERFACE'19*, Ankara, Turkey. arXiv:2001.00892

- Coppens, A., Mens, T., and Gallas, M.-A. (2018). Parametric modelling within immersive environments: Building a bridge between existing tools and virtual reality headsets. *36th eCAADe conference.* arXiv:1906.05532

- Dorta, T., Kinayoglu, G., and Hoffmann, M. (2016). Hyve-3d and the 3d cursor: Architectural co-design with freedom in virtual reality. *International Journal of Architectural Computing*, 14(2):87–102. DOI:10.1177/1478077116638921

Thank you!

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Results

Replication package