**Virtual Reality:** How can virtual reality be an effective tool for architectural design ideation?

**Abstract**

This paper explores the potential of virtual reality (VR) as a tool for architectural design ideation. The research investigates the use of VR as a method to conceive architecture without alienating the designer from the user's perspective. It is suggested that the holistic and subjective approach of immersive media is a necessary complement to the more abstracted and objective views of architectural tradition: plan, section, and elevation. The recent availability of consumer-grade VR allows the testing of this opportunity without many of the side-effects which hindered research done in the 90's. Looking forward, this research aims to describe tendencies of VR design and thus guide the incorporation of immersive technologies into contemporary practice.

To study these impacts, a real-time engine is used to develop an interactive program which allows the modelling of conceptual designs while immersed within them. Its efficacy is studied with three groups (architecture students, architects, and members of the public), from which quantitative and qualitative data is collected. By identifying the unique benefits of such tools, it is proposed how each group could make good use of the technology and extend the abilities of their existing workflows.

**This Thesis Is:**

- An Investigation of Immersive Architectural Design Processes
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**This Thesis Is Not:**

- Just a piece of software
- This Thesis Is:
  - Immersive Media
  - Research
  - Drawing Literature
  - Phenomenology

**A picture is not like perceiving.**

**If we are to understand what the experience of our designs will be like, and hope to improve that experience,**

Virtual reality offers a unique capacity for real-time feedback to be provided in a very intuitive form.

**The purpose of Architecture Representation**

- Function
- Geometry
- Experience
- Construction
Push/Pull
• Intuitive method of design
• Use for adjusting sizes
• Tends to promote extrusion
  • Initially only cubes introduced
  • Produces a distinct aesthetic
  • A 2-point method is chosen
  • Plane of rotation required
  • Difficult to define in VR
  • Breaks away from the grid
  • Defaults to axial movement
  • Pulls in direction of face
  • Free move option lacks control
  • Has great relevance in VR
  • Origin defaults to base
  • Danger of over-scaling
  • Changes world scale
  • Later removed to encourage 1:1 modelling
  • Copies establish pattern
  • Repetition evokes architectural qualities
  • Similar mechanics to ‘move’
  • Easily makes complex patterns (i.e. parametricism)
  • VR gives array dimensions greater human significance
  • Gives geometries a more realistic context
  • Increases model detail
  • Improves sense of texture
  • Rotational copy and array
  • Tends to produce geometries with less functional purpose
  • ‘Alien’ appearance when not careful
  • Allows more diverse geometries
  • Tends to prompt the design
  • Unusual results when combined with the 2-point creation method

Key Feedback:
• Don’t ask “what wins?” - ask “under what circumstances is this good in?”
• Explore how different modes of creation produce different aesthetic tendencies
• What is the role of a tool like this in the world?

Response:
• Thesis goals are revised to focus on the specific conditions it is effective rather than overall quality
• Tools such as ‘voxels’ and ‘morph’ test adding more ambiguity and a varied aesthetic into the process
• A more critical and realistic view of the tool’s potential was taken
• Refined the tool to include material manipulation
• Draw tool added to give the public a quick way to express ideas in 3D
• Completed an urban design experiment in Karori with the local residents

Shapes
• Allows different shapes to be used in combination
• Different shapes express different emotions and connotations
• A ‘sketch’ tool with greater ambiguity
• Tends to be defined by sphere at arm’s length

Voxels
• Acts as a drawing tool
• Becomes an effective volumetric massing tool at larger sizes

Morph
• ‘Alien’ appearance when not careful
• Allows different levels of detail
• Nesting groups quickly increases complexity

Radial
• Highly relevant in urban design
• Assumes certainty of the designer - undo required

Visible Settings
• Change capture settings while in a capture
• Change individual model settings

Evaluation Tools
• Very powerful settings for a more controlled design experience
• Allows the precise alignment and organisation of objects
• Important for anticipating construction requirements later

Material
• Change material settings while in the model

Draw
• ‘Sear’ tool for pen-like animation

Snap Settings
• Change capture settings while in a capture
• Change individual model settings

Visibility Settings
• Change capture settings while in a capture
• Change individual model settings
• Quickly reveal one material at a time

Review #01 Reflection:
• Don’t overstate what will be solved with this tool.
• Materiality is a significant part of our understanding of scale
• Renders are done for people who don’t understand our grammar
• “Is interactive VR an effective tool for engaging the non-architect in the design process?”

Review #02 Reflection:
• The world of interactive VR is still developing
• Typically not used when creating in a playful and unfocused way
• Contrast of views is important for deeper understanding, yet users tended to stick with the default.
• Useful for intuitively evaluating site properties
• Not frequently used, possibly due to the perceived lack of a need to be precise during the concept design stage
Q Is VR effective as a design tool for...

...architecture students?

**Experiment #1**

*The Competition*

The Results:

- Designers make significantly fewer actions when designing in virtual reality to produce similar results.

- Participants understood the scene well and were able to appreciate the spaces and building scales effectively.

- Participants found 3D ideation difficult and needed further training to use the tool to its full potential.

**Experiment #2**

*The Public Engagement*

The Results:

- The ‘Add’ function represented 82% of all actions.
- Model detail was rated the most significant factor for scene comprehension.
- No significant difference in action speed was measured.

**Exploration**
- Geometry
  - Design is a process of discovery and abstraction, influenced by the concept of geometric forms.
- Function
  - The tool’s usability is measured by its ability to visually represent and influence a user’s perspective.
- Experience
  - The tool is inherently viewpoint-oriented, which quickly reveals sightlines, etc.

**Refinement**
- Construction
  - The developed interface excels at conveying and manipulating experiential qualities of a design.
- Function
  - It has limited purpose in more detailed areas of the design process.
- Experience
  - It can be a powerful tool for designers to understand the potential of a design and explore its technical capabilities.

**Definition**
- Experience
  - This tool is best positioned for this side of the design process, e.g., adjusting dimensions, assessing daylighting.

**Communication**
- Experience
  - It is highly effective as an evaluation and adjustment tool.

**VR Visualisation**
- Observation
  - This tool is ideal for reflecting on the experience of a design. It communicates a sense of scale, drama, and atmospheric qualities.
- Function
  - The ‘morph’ tool uses randomness to create dynamic inspiration for concepts. It is one option for architects.
- Experience
  - The tool isn’t strictly necessary for this category of inspiration.

**Context-driven**
- The tool renders the landscape accurately, an advantage when site is unable to be accessed in person.
- Observation
  - Visiting precedents virtually could be valuable; however, it is not explored in this thesis.

**Demographics**
- Sun path
  - The tool is used in areas of the design process that lead to a detailed, technical understanding.
- Construction
  - Projects focused on construction needs have tight parameters and are less likely to benefit from the subjective design methods described.

**Biomimicry**
- Function
  - Design of geometry is only benefitted by the VR program insofar as it influences a user’s perspective.
- Experience
  - This tool lacks the depth of development for effective ideation at this level; yet, it is highly effective as an evaluation and adjustment tool.

**Manual**
- Function
  - The tool isn’t strictly necessary for this category of inspiration.
- Experience
  - This tool is best positioned for this side of the design process, e.g., adjusting dimensions, sense of progression, daylighting.

**Experience**
- Experience
  - This investigation suggests that VR is not ideal for construction documentation because of the technical intricacies involved. It is outside the scope of the tool’s capabilities.
- Function
  - A controlled ‘add’ mode is a useful way to create mock-ups and assess details visually.

**Potential Workflows**
- Conclusion
  - The developed interface excels at conveying and manipulating experiential qualities of a design.
- Function
  - It has limited purpose in more detailed areas of the design process.
- Experience
  - Architecture students were able to use the tool to express conceptual ideas efficiently.
- Construction
  - Participatory VR design with the public requires close guidance to maximise engagement.