# New technics of selection, manipulation and placement of objects for editing in Virtual Reality

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# 1 Introduction

As Virtual Reality(VR in later parts of the document) popularity growth, there is more and more developers and designers working with that type of apps. But when it comes to making scenes in VR, we come to problems. We can make scene on a regular computer monitor, but it is very difficult to see it from players perspective and developers must then test it on VR headset. In my project i want to try to solve this problem - what if we already done scene in VR?

In this work i will be focusing on observing current ways of selection, manipulation and placement of objects for editing in VR and implementing my own vision of object selection problem solution.

# 2 Current object manipulation, selection and placement methods in VR

Effective 3D objects manipulation and scene creation is an old problem. For example "3D Palette: A Virtual Reality Content Creation Tool", a 1997 paper about interface for creating 3D virtual scenes, tried to solve that problem with graphics tablet and voice recognition technology: "3D Palette consists of a Wacom tablet and digitizing pen, both of which are tracked in space using Polhemus Fastrak electromagnetic sensors, a head-mounted microphone and a pair of CrystalEyes stereoscopic shutter glasses. The user holds the tablet in one hand while interacting with the scene using 2D and 3D pen gestures and voice commands"

The closest to our goal real use of doing scene in VR is ShapesXR - tool for making 3D models, sounds, scenes in VR, which than can be exported to Unity game engine. There is even a possibility to work as a team on one project, that can help produce content faster. Also worth mentioning AR home designing apps like IKEA Place and PLNAR where you also can manage scenes(in this case your own room or house).

Visual programming is a technique, where programming code is replaced with visual nodes. One of the most popular realisations are Scratch(made for beginner programmers who want to understand programming principles) and Unreal Engine Blueprints Visual Scripting(game development, focused more on game designers with little programming experience). Also, exists "EntangleVR: A Visual Programming Interface for Virtual Reality Interactive Scene Generation". Paper describes visual programming system based on quantum computing - "Quantum computing offers many interesting concepts that can be applied to creative computing like interactive scene creation for virtual reality (VR) or game design and other forms of experiential media. Entanglement,

a phenomenon that is at the heart of disparity between classical and quantum physics, describes a correlated relationship between the measurement of multiple spatially separated particles [2, 27]. As a unique feature of quantum computing, it transforms individual object states into non-separable shared states, allowing a single interaction on one object's state to affect all the entangled object states as a whole [22].". Also, technology will be expanded in the future - "We will also expand our system by adding entanglement at different scene creation scales (e.g., procedural scene generation, multi-scene entanglement)."

As for procedural generation, it is very helpful technique that can create many models, big terrains, etc. from small amount of data. It is a little bit difficult to implement algorithm, but it is relatively easy to work with and understand implemented solution. There are even proposal of proceduraly generated stories - "The procedural generation of stories has many advantages [142–144]. First of all, creating storiesis expensive; many artists, content designers, programmers and audio engineers are usually involved.This effort can be reduced considerably if PCG for stories is employed [145]. Second, when new storyvariations are created at runtime, this can keep players motivated when replaying the game [144,146].Third, it becomes possible to generate stories that automatically adapt to the players' skills andpreferences [147]"

# 3 Proposal

Manipulating objects in VR is not a

As i observed, in my opinion there are those ways of making usable and comfort environment for creating scenes in VR:

- pattern recognition, choosing object by drawing shapes

- voice recognition, choosing object by saying its name

- selecting object from list

- their combinations

My work will be focused on object selection using pattern recognition technology. User will be drawing shapes with his controller motion capture, which then will be translated to text using AI(Artificial Intelligence) recognition algorithms. That text will represent object name, with which we can then add that object to our scene.

For now I will be implementing only Pattern Recognition approach. I was inspired by article on medium.com "Neural Nets + VR = Magic! ".

# 4    Implementation

I have started my work with creation of pattern recognition algorithm. In Unity Asset store exists extension called "PDollar Point-Cloud Gesture Recognizer" that gathers points from input gesture and, with help of cloud technology, returns guessed gesture name(if guessed) and score(zero if not guessed). Also, i used video from Valem's channel called "How to Detect a Movement in VR - Unity VR Tutorial" parts one and two as reference of PDollar library usage. Here are some examples of gestures sketches and in app representations:

Figure 1: Fabric Sketch



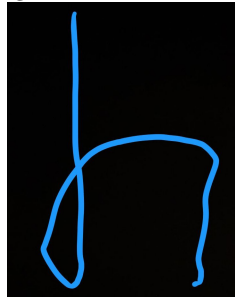Figure 2: Stool Sketch



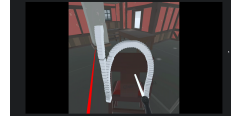Figure 3: Chair Sketch



Figure 4: Chair Gesture
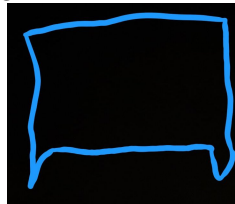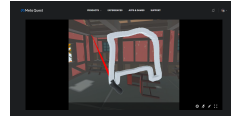


Figure 5: Cabinet Sketch



Figure 6: Cabinet Gesture



Movement and object manipulations are done with XR Interaction Toolkit(built in Unity Game Engine package).

**Controls:**

- Right Controller:

  - Trigger - draw gesture
  - Grip button - grab object
  - Controll Stick - left
    right - camera turn, forward
    backward - adjust object distance.

- Left Controller:

  - Primary button - save created objects
  - Secondary button - change mode(Traing Gesture/ Gesture Recognition)
  - Grip button - delete object
  - Controll Stick - all directions - move camera

**Bugs**  1. When grabbed, object is move in players direction a little bit (also rotation of the object is changed). I have found video about solving this issue, however despite following all the steps, problem wasn't solved. All the other options also seemed to have no effect.

2. When object is grabbed and very close to camera, it can change players position a little bit. I think that it can be changed by adjusting camera and objects layer in Unity.

## 5   Testing

For the testing I have created sample scene using Polygon Fantasy Kingdom assets - house with interior and two houses without interior. Then the tester composes scene on regular monitor for first house without interior and composes scene in VR for second house. Each tester tested program separately and didn't know what scene must be composed.

I have tested my implementation on 5 people of different age. Unfortunately, not every person had previous game development experience, but, despite it, they also gave some useful information to improve project.

All of the testers, except one, agreed that scene creation in VR is more intuitive and practical than in 2D monitor space. But, for majority(three people) ordinary object selection(selection of objects from the list) is more preferable. "You can select and spawn more than one object from the list, and then just adjust their individual placement and direction" - one of the testers words.

Some of the testers suggested to add disabling collision by button(for placement time) and object attraction(example: placing object on the same Y axis coordinates as at neighbour objects). Also, they proposed to add 360 degree 3 axis object rotation with Control Stick on controller(there are only one axis rotation in my implementation now).

At least in this implementation of shapes recognition(PDollar) not recognize different hand writings. For example: i have trained model on my handwriting shapes, but some testers had troubles with gesture drawing.

Bug feedback is in the Implementation section.

# 6 Conclusion

While implementing, I have noticed those disadvantages:

- 3D artists must do additional work, for example write gesture for model, train AI to recognize gestures, add components to move objects in VR

- It is difficult to invent new gestures for objects, the more objects are, the less possibilities for new object gesture you have. Also all the gestures are draw in 2D space and with one move(in my representation)

In my opinion gesture recognition would be more preferable in game play, for entertainment, rather then in games creation. As for VR world creation, development in VR gives more perspectives. Errors are found faster, their fixes are immediate, you don't have to take off your VR headset.

VR world creation needs combination of those methods, would be great to combine all of them(list, gesture recognition, procedural generation, etc.), so game developers can choose more suitable methods for them and their teams purposes.

# 7 Links and Sources

Whole Unity project is too big, i will upload only part of it on BRUTE, other part will be at my github repository - https://github.com/dmytrokadar/SemestralVR
https://www.shapesxr.com/
https://www.citationmachine.net - citations
https://unity.com/
https://medium.com/hackernoon/neural-nets-vr-magic-3b066538aa5d
https://apps.apple.com/us/app/ikea-place/id1279244498
https://apps.apple.com/app/plnar/id1282049921
3D palette: A virtual reality content creation tool - researchgate. (n.d.). Retrieved February 3, 2023, from https://www.researchgate.net/publication/221314329_3D_Palette_A_virtual_real
Mengyu Chen Media Arts and Technology, Chen, M., Technology, M. A. and,

Marko Peljhan Media Arts and Technology, Peljhan, M., Science, M. S. C., Sra, M., Science, C., University, A. G., University, T., University, O., California, U. of, Tokyo, T. U. of, Canterbury, U. of, &amp; Metrics, O. M. V. A. (2021, December 1). ENTANGLEVR: A visual programming interface for virtual reality interactive scene generation: Proceedings of the 27th ACM Symposium on Virtual Reality Software and Technology. ACM Conferences. Retrieved February 3, 2023, from https://dl.acm.org/doi/10.1145/3489849.3489872

A survey on the procedural generation of virtual worlds - researchgate. (n.d.). Retrieved February 3, 2023, from https://www.researchgate.net/publication/320722498_A_Survey_on_the_Proce

https://assetstore.unity.com/packages/tools/input-management/pdollar-point-cloud-gesture-recognizer-21660

https://www.youtube.com/watch?v=GRSOrkmasMM - video with PDollar usage

https://www.youtube.com/watch?v=kfA_73npjMA - second part of that video

https://www.youtube.com/watch?v=XRaNYOXU0hw - video with first bug potential fix

https://docs.unity3d.com/Packages/com.unity.xr.interaction.toolkit@2.2/manual/index.html

https://syntystore.com/products/polygon-fantasy-kingdom