

VIRTUAL HANDS OF THE ARCHITECT

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M.ARCH (Professional)

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Virtual Hands of the Architect - VR Thesis

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0 - Abstract

The Thesis studies Virtual Reality Drawing and its application to architecture. It covers the evolution of different thesis goals, from a more technically intensive approach to the now experimental method of research. It also covers a short background about Virtual Reality's history, my personal history with drawing, old projects remodelled for VR, or redrawn in VR, and finally new projects like a short interactive game and a VR space.

The research includes an insight to VR drawing – of typical 2D / 3D drawing elements such as line, shape, shade, etc. and then compared to their VR counterparts. Also included are VR architecture drawings and the video of the process and the analysis of how the process informs architecture. The data gathered from these VR drawings experiments and comparisons will be read as a guideline for VR art that shall be used to make the final pieces – the Thesis Game (contains images / text / data) and the Final VR Drawing Space

In Conclusion, I find VR-drawing to be an interesting new medium. One that has its own set of rules, its advantages and flaws. In drawing architecture, it shows intuitiveness while sacrificing accuracy of other media. With practice, it can produce fast – provided you get past the performance and learning curve. In showcasing architecture, it provides an unlimited digital space inside a limited physical space. VR drawing for architecture must be further studied with a bigger user group with a wider subject, in order to find out more about what it brings and what it can improve upon.

1 - Introduction

1 - Introduction

1.1 - Introduction - The Project

This was an unconventional thesis. Its method is self-referential in developing a new method of three-dimensional drawing in Virtual Reality. Its aim, to find out how VR can affect architectural design through drawing, sought to develop a viable, effective, new form of art. In this manner the thesis is process driven, developing much of the work as a series of observational exercises and case studies in an effort to understand the implications of drawing in VR and to form some form of lexicon by which it might be examined in the future. This is therefore a field of study very much in its nascent stages of academic scholarship.

This thesis studies how Virtual and Augmented Reality (VR & AR respectively) applies to architecture. Initially, the thesis aimed at creating a VR/AR program / system where multiple users could design architecture collaboratively in real time. As the thesis progressed, however, it shifted away from real-time programming towards questions of VR for architecture and its relationship to drawing – how drawing might change, improve, and evolve using VR/AR? This is done by: 1) putting drawings in the physical world (AR), 2) putting drawings in the digital world (VR viewing), 3) merging drawings and architecture (VR walkthrough) and lastly, 4) drawing and designing within Virtual Reality (Using VR goggles and 3D wands).

I am interested in this topic because I see it as the perfect combination of my own personal fields of interest: architecture, video games, and comics and my enjoyment of drawing. I am interested in architecture for the beauty of the built environment, Videogames for its immersion and technological advancements, and comics for its unique storytelling method. Virtual Reality has the potential to combine these diverse fields into one area of study. Lastly, in relation to drawing, AR/VR is another way to draw. I have learned to draw with a pen. I have learned to draw with a program. Now I want to see what I could draw with virtual tools in a virtual space.

Drawing is an art form – and like other forms of art, a new medium brings out new qualities and techniques not previously seen with older medium. The Digital medium, just like the traditional medium, has its own tools and its own rules. Virtual Reality's role as a new drawing input and drawing output is important to study – that it will grow to have its own rules and methods.

VR is the next great leap - another dimension. It is as significant as when we transitioned to digital drawing. It will be a merger of worlds, the digital art world and the traditional art world. Once VR shows promise as an easy drawing tool, then everyone can enjoy VR – and VR will be utilized for making and viewing designs.

The thesis speculates that VR will benefit: architects and their clients, engineers, designers, artists, and the general public in understanding new architectural proposals. Architects will benefit from innovative and efficient ways of drawing and designing. If Virtual Reality architecture is further improved, it could prove to be a viable addition to common representational techniques and conventions of architecture besides plans, renders, and videos.

The clients will benefit because they will be able to gain an immersive experience of the interiors of their designs, giving another level of spatial understanding. Engineers collaborating with architects will benefit as there could be a better understanding of their designs and VR can simulate particular issues to inform engineer's of their calculations / solutions.

Artists are given another dimension (or another realm) to explore and express themselves. Space is no longer a matter of physical limitation as artists and their art can overlap digitally, and drawing and painting will start going beyond the “flatland”. The public benefits, as VR is slowly introduced to education and entertainment, its introduction to design will give them a better overall experience with existing media. It matters because, even with my interest in technology and games in general, it still managed to surprise me. The Virtual Boy is a VR device by Nintendo released in 1995, and immediately discontinued in 1996. 10 years later, Nintendo released the Wii in 2006, a videogame console with wireless motion controllers as its main feature. I was too young to know about the Virtual Boy device, and the Wii motion controls were fun but I never really dodged, broke into sweat, and felt it was worth it, until 10 more years, 2016, when Steam VR HTC Vive was released for the consumers. Then I was dodging the virtual things thrown at me.

Besides entertainment, VR is no longer a product of science, but also a method of science – in medicine even. In a 2014 paper, an experiment with lab rats showed that the brain perceives VR differently than the real world. That movement in VR is mostly visual – while moving in the physical world has more spatial senses. This study proves that how we move is just as important as how much we see when it comes to brain activity in VR. ¹ In a 2016 paper, Ana R.C. Donati, and 19 other scientists were using VR to aid in the recovery of locomotor skills of paraplegic patients. All eight paraplegic participants regained some sensation and control. ²

If VR connects the minds and ideas of the architect with the wants and needs of the public, then we will come up with holistic design that people will enjoy and take functional advantages.

1. (Aghajan, et al. 2014)
2. (Donati, et al. 2016)

1.2 - Background

Stanley Weibnaum described what would eventually be virtual reality in his science fiction story Pygmalion's Spectacles (1930s). Masamune Shirow (Ghost in the Shell Virtual Reality Diver), Lisberger & Bonnie MacBird (Tron) and The Wachowskis (The Matrix series) are all writers for movies that deal with advanced technologies creating and simulating new realities. I am also looking into Philip K. Dick's many science fiction stories and a notable quote: "Reality is that which, when you stop believing in it, doesn't go away"¹

There are significant innovators and writers that have contributed to the field of Virtual Reality. This includes Morton Heilig who invented the Sensorama, (1950s) the first 3D movie machine and the first head mounted display in 1960. These HMD's are also commonly known today as Virtual Reality Goggles – the Oculus Rift, and HTC Vive being the more popular consumer products today. Technopedia.com defines Head Mounted Displays (or HMDs) as a "type of computer display device or monitor that, as the name implies, is worn on the head or is built in as part of a helmet"². This device is important as it creates immersion to the experience "as it ensures that no matter where the user's head may turn, the display is positioned right in front of the user's eyes"³ limiting the user's vision to only what the HMD shows and synchronizing head movement to visual "trick" the mind into this new "reality."

Douglas Engelbart is credited with creating the first graphical user interface (GUI) in the 1960s. Webopedia defines Graphical User Interface as "a program interface that takes advantage of the computer's graphics capabilities to make the program easier to use."⁴ This means instead of lines of commands as an interface, it uses visual items such as icons, pointers, windows, desktops, menus, etc. Besides GUI, Douglas also invented the such as the computer Mouse, today's standard pointing input device

Jaron Lanier coined the term Virtual Reality in 1987.⁵ His company, VPL Research were the first company to sell VR products, both hardware and software, including the EyePhone.

Palmer Luckey's Oculus Rift prototype (2011) and Oculus VR started today's new VR boom – with many companies developing their own devices - growing into the industry that it is today, with hopes to fulfil what 90s VR promised in TV commercial and promotions – but could not deliver because the quality and speed of the graphics. Today there remains a disconnect.

1 (Dick 1985)

2 (technopedia.com n.d.)

3 (technopedia.com n.d.)

4 (webopedia.com n.d.)

5 (JaronLanier.com n.d.)

**"Reality is that which,
when you stop believing in it,
doesn't go away"¹**

- Philip K. Dick

I Hope I Shall Arrive Soon (1985)

1.3 - Limitations and Scope

This research will cover the implications and benefits a small facet of the potential of Virtual Reality and Augmented Reality in relation to drawing architecture, and specifically my method of drawing, which is focused on gaming and comics for inspiration.

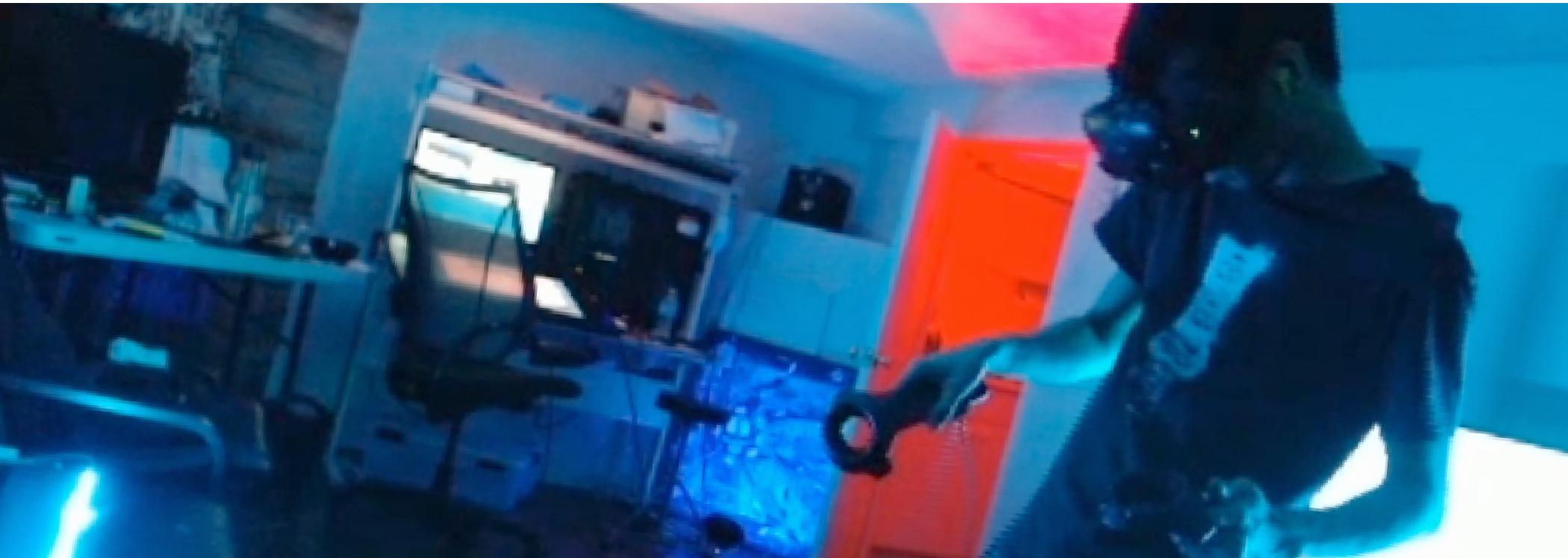
Scope

- Research and Demonstrate a VR environment (VR goggles)
- Research and Demonstrate drawing and manipulating within VR (VR wands and hands)
- Study the difference of drawing in 3D space, free body movement,

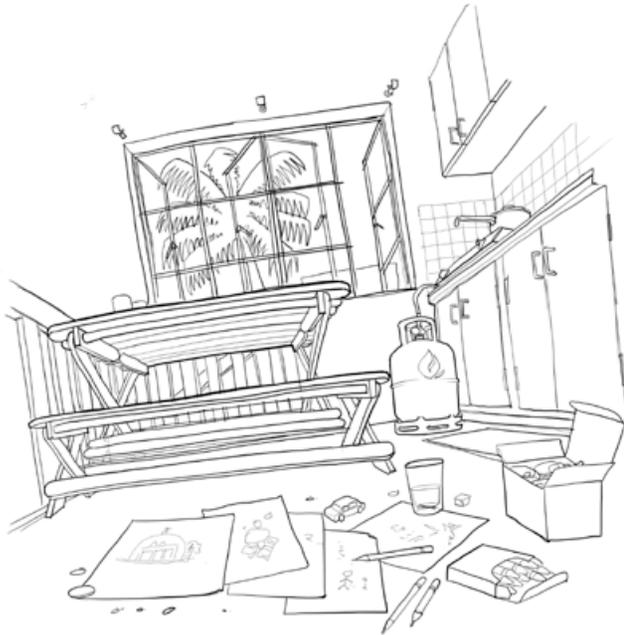
- Brief on how VR evolved to what it is today
- Brief on current and existing VR / AR technologies being used for architecture (professionally and academically)
- Show other uses of VR in other fields and compare how these technologies can be modified to fit architectural and design needs
- Conceptualize future VR/AR technologies that you foresee based on how the industry is going at the moment and how VR/AR tech will fill such needs.
- Research and Demonstrate an AR drawing (AR tablet)

Limitations

- Project will not go exploring VR for entertainment purposes (not be making traditional games with win/lose mechanic)
- Project will not be creating a working software / system for these ideas to work on. But merely working on a concept on how existing technologies can create this future combined technology that doesn't exist yet. (we have the parts, now we imagine what it can built together)



2 - Why I Draw



1994-'99 - Elementary school, Gundam, Pokemon, PvPcomics



2 - Why I Draw

The objective of this thesis is to study the effect of Virtual Reality to drawing architecture. To understand this development it is key describe why I draw – how my reasoning affected my technique and my technique affected my reasoning. It is important before I delve into the technology and answer the ‘how’, I have to elaborate the ‘why’.

2.1 - From Home to School: Why I started drawing

In my childhood, I grew up in a house in front of a cathedral – the first thing I clearly remember drawing on a small piece of paper on the wooden living room floor. Architecture was not a word to me, just buildings, maybe even merely just shapes. I drew things around the house, toys, and cartoons. **I started drawing what I saw.**

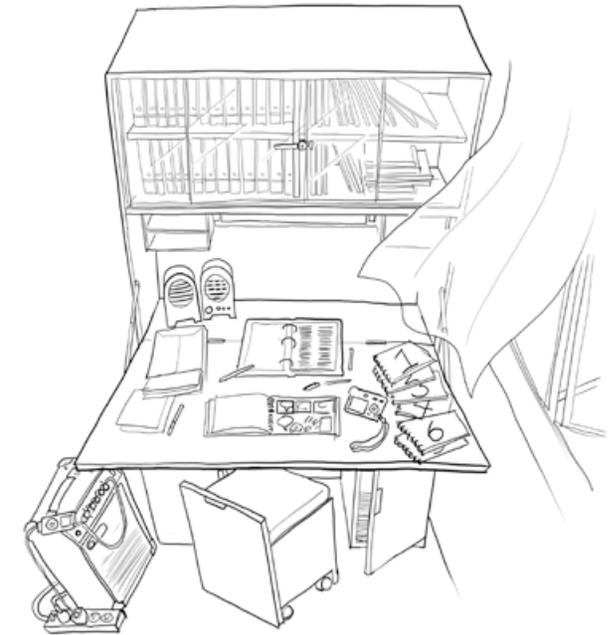
At toy stores, I would memorize each robots I cannot afford then draw them at home - If I drew it, I felt like I had it. Before the internet was accessible, the only way to re-live movies was to remember details of the film, retain it mentally until I got home and reached for my sketchbook. **I started drawing what I did not see.**

All this drawing of what I saw helped build a depository that would eventually help me draw what I did not see This came in handy as my family plays the board game Pictionary – a draw-and-guess board game. I found the game fun, but drawing the object in plain view was not enough – I started drawing the objects or ideas from unconventional angles. **I started drawing what I thought.**



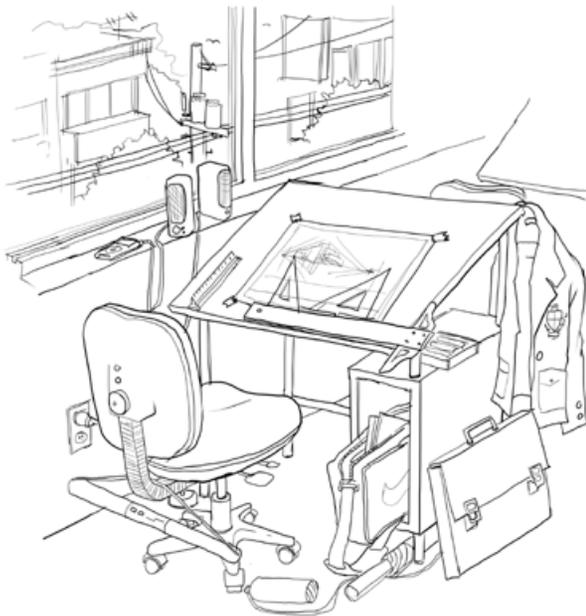
2000-'07 - Mid-Highschool, ink! comics, manga, cars, the occult





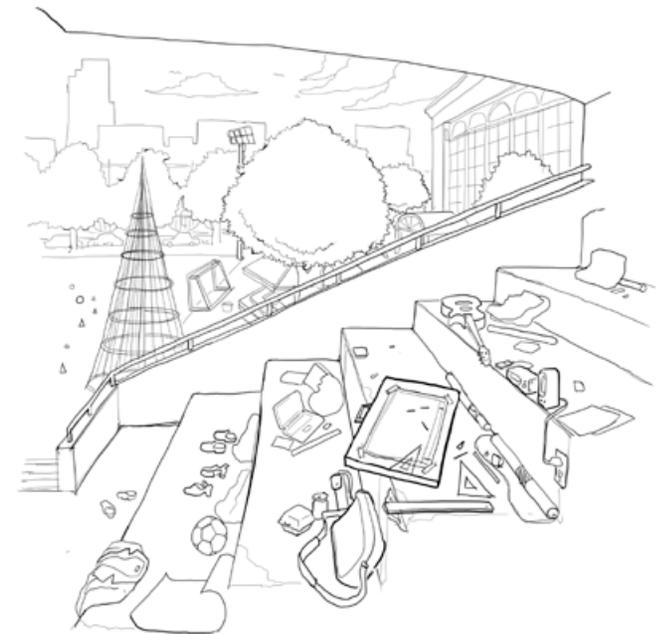
I had a memorable time in grade school because I remember being able to draw every chance I could get. I started to appreciate recognition from my peers for my classroom doodles. I started drawing not just for myself but for others' entertainment. I began entering local to national drawing competitions – realizing that there was a certain formula to what gets the judges to pick your work – impact. **I started drawing for attention.**

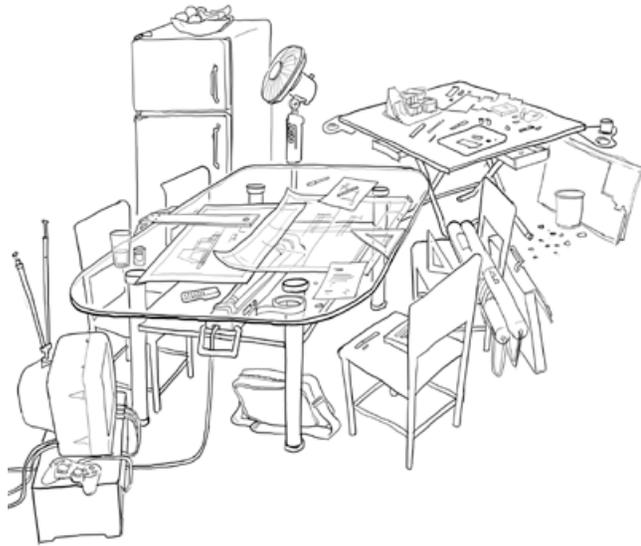
2007-'08 University of Santo Tomas - Architecture 1st year



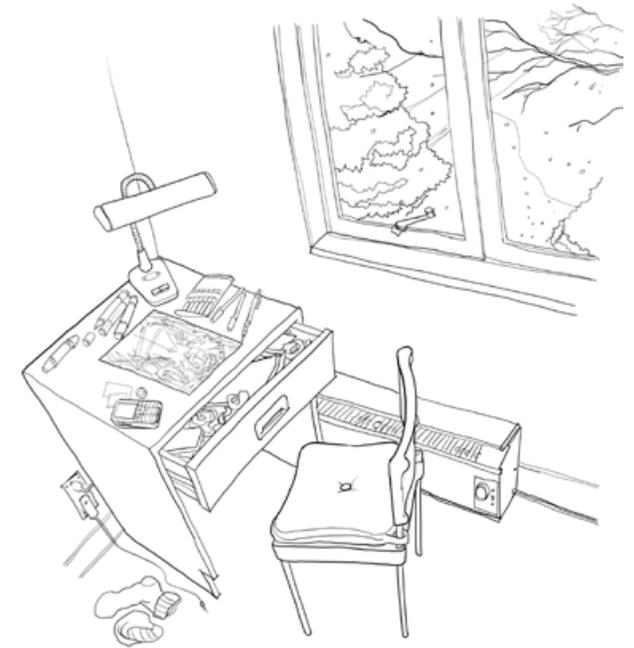
At a young age, I figured I should somehow make a career out of a hobby. But a career is only viable if it can make money, so I started by selling hand drawn bookmarks – not much profit but it was a lesson learned – my art could be sold. This was an idea that is even clearer to me today. I started drawing for money. In high school, I had become more proficient in comic book and cartoon drawing – depicting classmates fighting super heroes, serious autobiographical comics, to political cartoons. I printed social commentary posters and spread them around. **I started drawing for ideas.**

2007-'08 UST Grandstand - after-class freshmen outdoor exiles

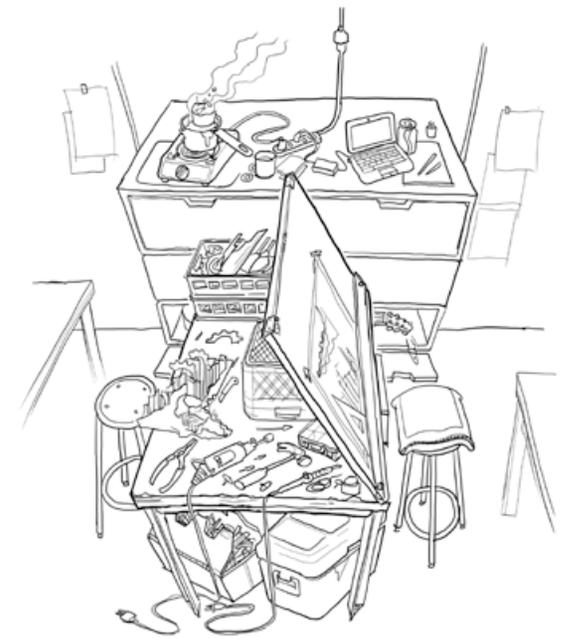




2009 Fall - Carleton University Azrieli School of Architecture & Urbanism



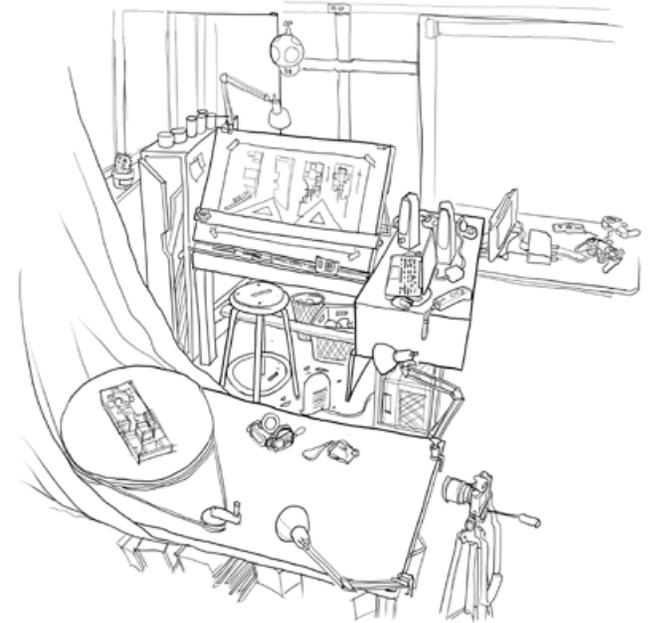
2010 Winter Y1S2 - rusting sharp metal and melting hot wax



Architecture gave me opportunities to be influenced by my other interests: the immersion from video games and the narrative and comic books.

When I was making my portfolio to enter my graduate studies in architecture, I noticed a recurring theme: one point perspective view of a narrow pass with stark lighting and great detail. I figured this pattern had to have a reason behind it.

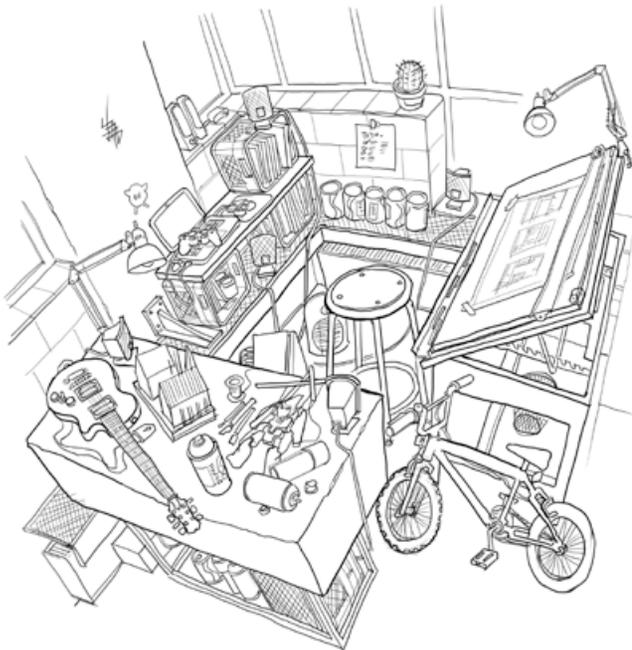
My undergraduate Bachelor of Architectural Studies (BAS) entrance portfolio included a drawing entitled "Gothic Industrial". It depicts me as an artist in a ravine of two walls of contrasting styles. "Light Trick Toilet Pavilion" uses a hallway pointing towards a lake with both walls mirrored, and one end open towards the body of water - creating the illusion of an infinite horizon. "Comic Portal" is the opposite by going underground, warm and dark with Death Star shapes and Mordor hues to match fictional themes of the books they sell. "Forget to Remember: Remember to Forget" is a library that embraces isolation, with a tall, book shelf laden atrium leading to a room on the roof surrounded by the hum of the mechanical systems - lit only by the light from a square opening above. "The Mind, Archifiction, Welcome, Denied" are a few of my Murray-Murray drawing competition entries that show the density of my ideas. I am compelled to have an erratic, heavy, grandiose, or plain angry drawing - whichever emotion needs to go with the idea.

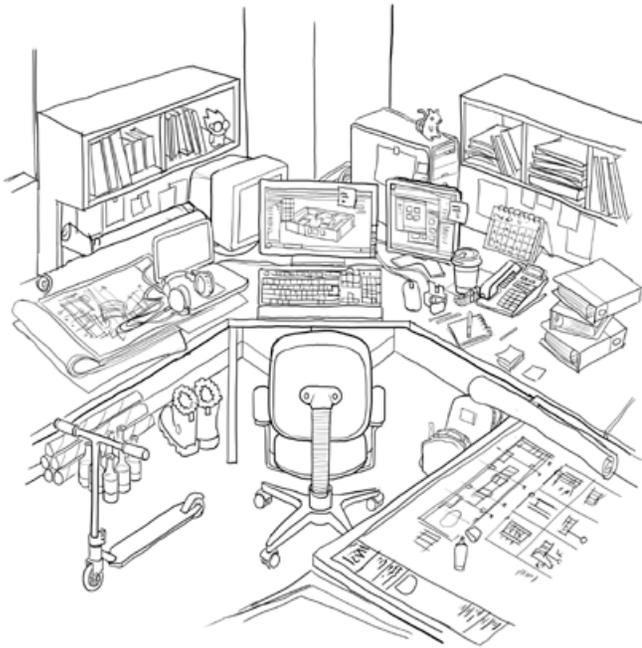


2011 Winter Y2S2 - makeshift turntables, Wii super smash bros

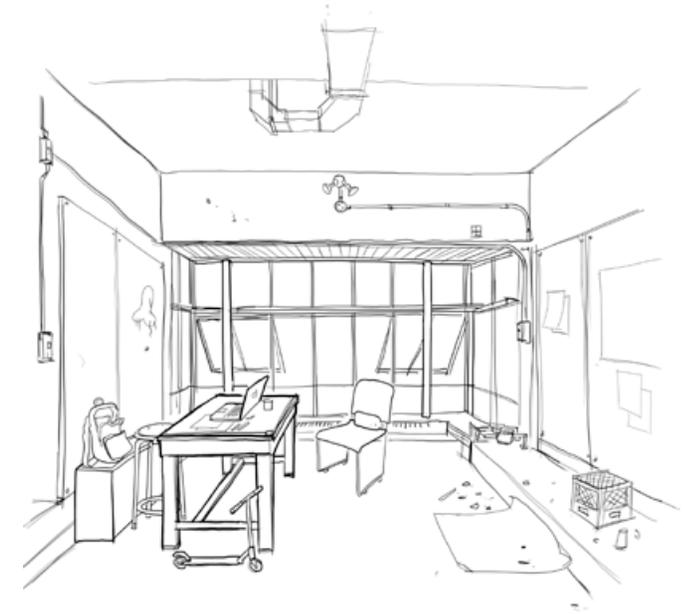
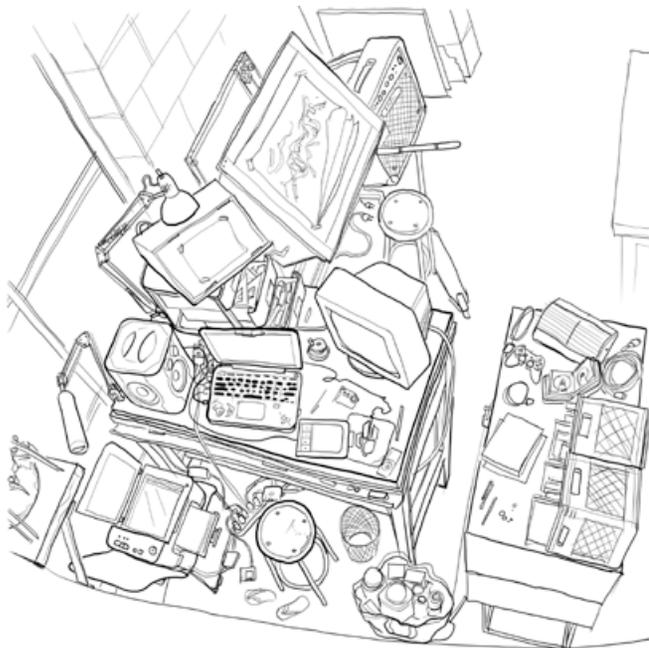
Architecture drawing for me became an exercise in immersing both myself and my viewer. With influences from Kris Kuksi, (a mixed media gothic baroque modern surrealist sculptor/arranger), and La Sagrada Familia (by Antoni Gaudi), I exemplify immersion by surrounding the gaze of the viewer with layers upon layers of detail, each element complementing the next to create an overall feel. ***I was drawing to give immersion.***

2012 Winter Y3S2 - LAN gaming, first drawing tablet, Revit





013 Fall Y4S1 - own scanner, tracing box/desk, PS3, SketchUp



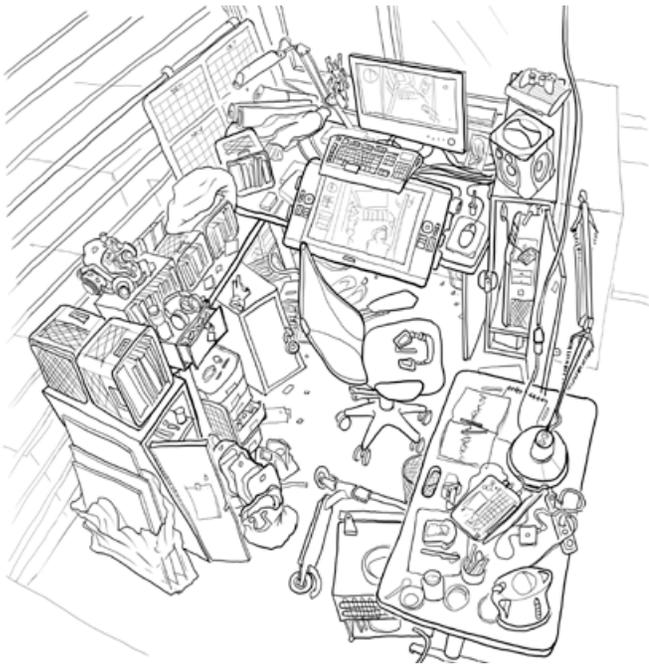
2014 Winter Y4S2 - senior yr, graphic novel station w/ an ok chair



Whenever I am doing a presentation in architecture, I have noticed a similar trait: I present it to my critics as a walkthrough. I narrate entering the building, where the junctions are, what they see, what they climb, what they go through, how they reach the top, etc. I figured this pattern also had a reasoning behind it.

The drawing “Wall of Sorrows” depicts a fictional, bloody, violent ruin. Each component of the wall has its own story, and the entire wall has a historical / archaeological treatment. “Crossroads” is a Blues institute where people, as walk through its spaces, the same pattern as their memories are scribed onto a wall get in the process of becoming turned into a song and then later performed. “The Gates” is a waterfront public and residence building, a horizontal story, while the “Himpapawid Tower” is a giant air pollution-cleaning tower, a vertical story. “Glacierport 01” is an arctic iceberg and ice sheet generating facility – the narrative here is quite extensive and literal – being an extremely long building, I figured a plan won’t do it justice so I created a story about its origin, purpose, and eventual re-purpose in the form of a environmental terrorist attack and hostage rescue mission in the form of a printed graphic novel.

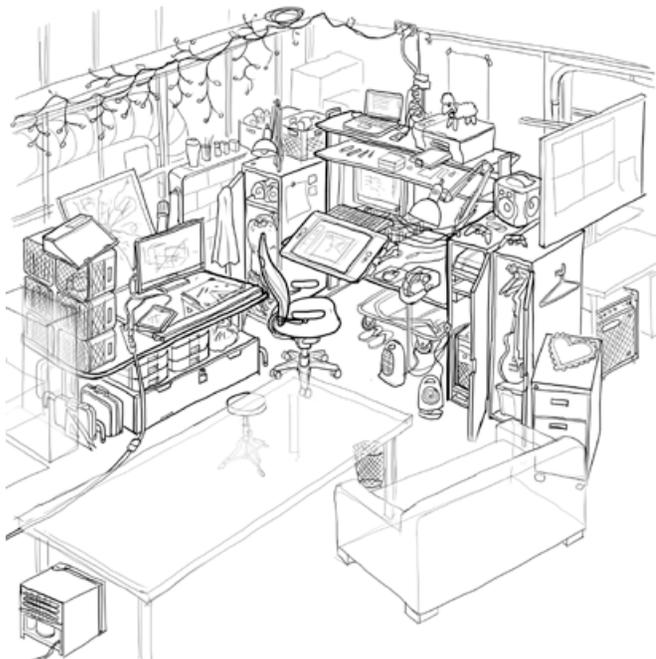
2014 Fall GradSchool Y1S1- exiled to Azrieli Pavilion - PC+Cintiq



2015 Winter Grad Y1S2 - 4 lockers, 3 desks, 2 guitars, 1 fridge

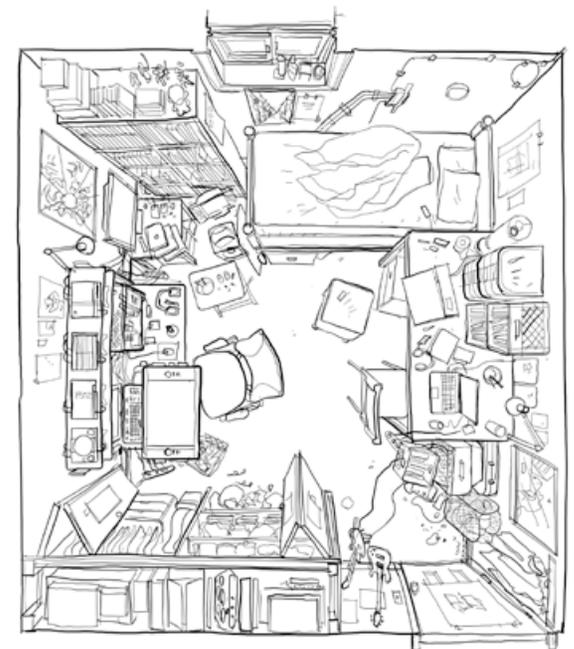


2015 Fall - 2016 Midwinter Grad Y2 - Architecture Masters Thesis



These architecture drawing became an exercise in narrating a story. With influences from Kim Jung Gi (a Korean artist skilled in hand drawn collages), and several comic book artists like Inio Asano (a Japanese artist who delves deep into character's flaws) and Junji Ito (another Japanese artist with a wide horror range from gory to sublime) , I show that narration is in both the final product (the destination) as well as the process (the journey), with each part of narrative, built and framed in the most interesting angles, leading the viewer from one view to the next without saying words, connecting to each other to create an overall story. **I was drawing to give narrative.**

2016 Midwinter-Spring Grad Y2~ - basement thesis, sick at home



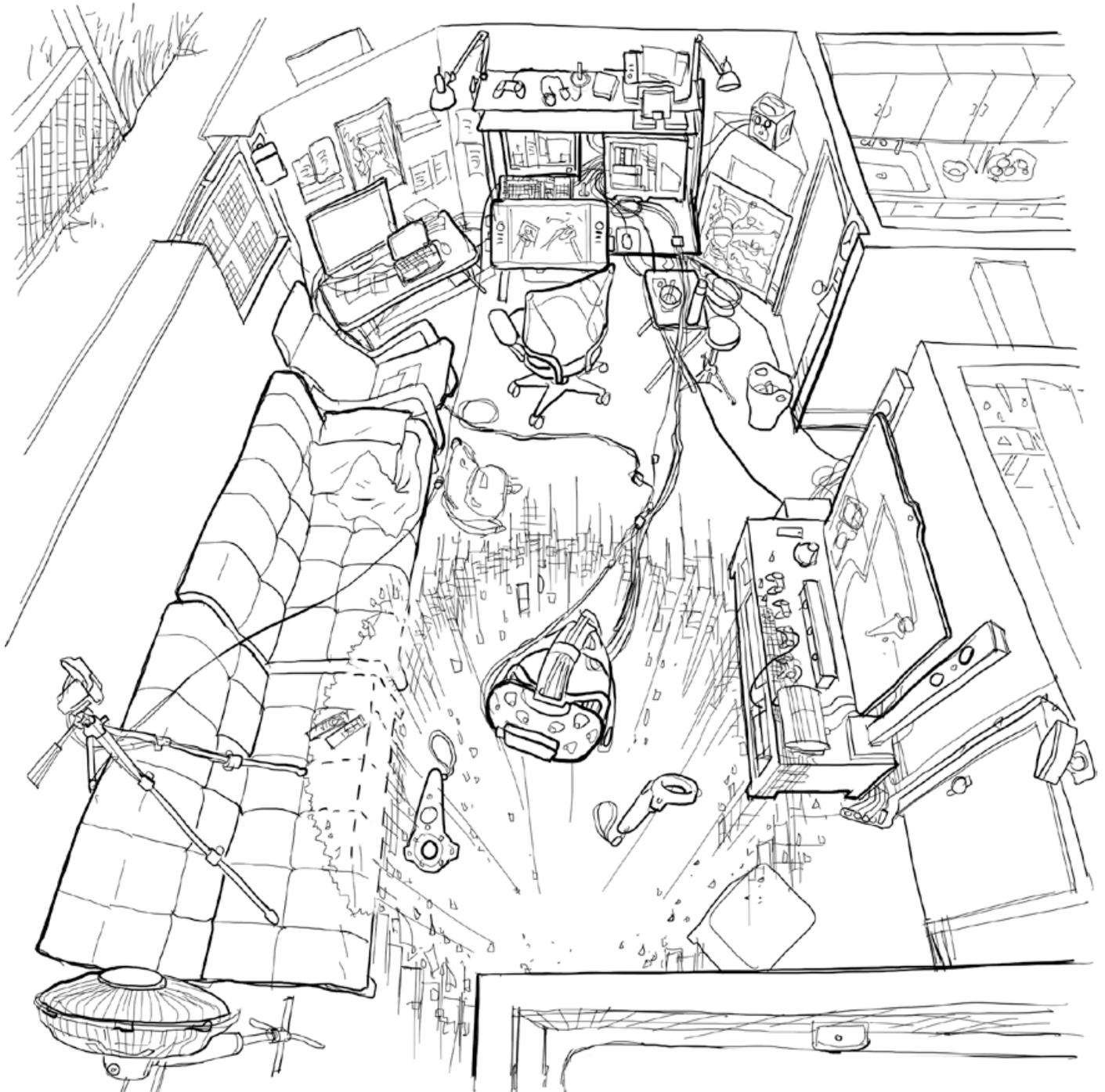
2.2 – VR: Continuing to Draw in a new dimension

With the awareness of my skills, influences, methods of thinking and drawings I have come to this thesis and the conclusion that the next step is to draw in the next dimension.

I started in ink since I was a child, a couple of years ago I started in the digital medium, and just recently, Virtual Reality became a possible drawing medium. Before I ask ‘how I can draw in VR’, I will answer ‘why I should draw in VR’. This is because a thesis must not only be enjoyable but rather, to be more productive, it should be an investigation to the possible evolution of my favorite hobby: drawing. The project should not merely be a ‘nice drawing’. VR will not make me a better drawer – it will only give me a new set of tools. What I do with these tools and how I learn from them is what will make me a better artist, a better designer, and a better architect. ***To be able to draw in VR in real time (without leaving VR space and breaking immersion) will get me, and other artists, closer to having the medium be at the same speed as the artist’s imagination.*** The technology is finally close to our dreams and fictions from the past.

Drawing to be a pioneer for this new medium

2016 Summer - basement archi-thesis, Virtual Reality Drawing >



2.3 - Context: History – Visionary Architecture and Science Fiction

2.3.1 - Visionary Etchings - Piranesi

The following section explores a number of contemporary architects, artists and graphic novelists to give context to the VR work and place it in a larger lineage of spatial drawing.

Virtual Reality's immediate advantage over other mediums is its immersion in a created a separate reality / world, a fantasy. VR drawings take the viewer to a place depicted by the artist. Historically, "Vedutas" are paintings or etchings of a detail scene - often landscapes or cityscapes. These views intended for tourists¹ acted as memoir of the place, a portable, virtual version of the location.

VR drawing, though infinite in space and digitally alterable, suffers from similar issues from the traditional arts like paintings and etchings. They are still bound by the simplicity of the base medium's control (the single hand) and the starting 'canvas' (the room space in VR, the rectangular canvases). The monotony I noticed in VR is that a new piece always starts in a void – one cannot see the physical room, a window, reference books, models, sketches etc. It is asking you to draw from memory/imagination. This limits the work to bursts of ideas – singular, unitized ideas per VR piece – instead of a painting on an easel one can easily go back into and leave, - VR demands quicker starts and even quicker ends.

According to Holden, Piranesi mostly sketched on site to remember, while starting the drawing over again when back in his studio. Piranesi was known to work very rapidly.² The speed at which these VR drawings must be done also changes the value each piece – trying to make each VR drawing special – and stand on its own, even if it means altering the intended architecture. Pannini, (one of Piranesi's influences in Rome) made a new type of veduta, called "capriccio" or architectural fantasy, "collection of accurate representation of ancient buildings and sculpture but are arranged capriciously to make a pleasing medley rather than a record of fact"³ This includes shifting building elements (or entire buildings) to fit the canvas.



Veduta di Campo Vaccino. Piranesi 1772

1 (Murray 1971)

2 (Holden 2014)

3 (Murray 1971)

According to Horace Walpole, Piranesi is “more concerned with effect than with the truth” ,¹ not only in arrangement, but emphasis – bolder lines for darker foregrounds contrasting faint lines for hazy backgrounds. In both ink engravings and VR (single brush only), the difference in density and heaviness of lines is the quick way to achieve the depth these architectures / landscapes need.

Besides the depth of the image, there is also depth of the medium, more passes of the engravings, acid baths, creates darker and darker prints – while in VR, one must do multiple passes to cover more viewing angles, to make the piece, as a whole, more opaque. There is a clear proportion on density achieved over time spent putting the strokes in.



Carceri d'invenzione (Imaginary Prisons) Plate X: Prisoners on a Projecting Platform. Piranesi. 1750

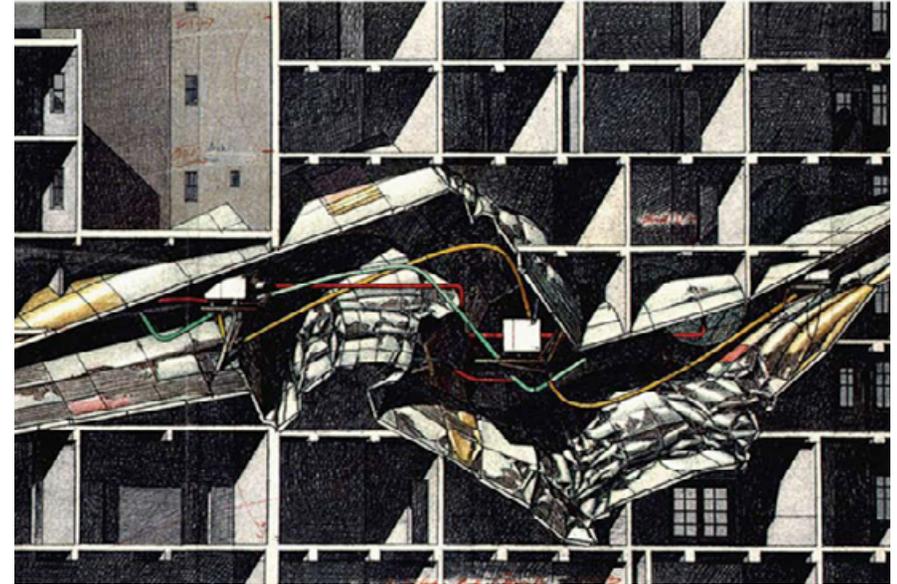
1 (Murray 1971)

2.3.2 - Paper Architect - Lebbeus Woods

Skipping to more modern times, Lebbeus Woods, an American Architect (1940-2012) describes visionary architecture in his blog using two examples (from Steven Holl and Le Corbusier) sharing three traits:

1. “The projects propose new principles by which to design for the urban conditions they address.”
2. “The designs are total in scope”
3. “The designs invent new types of buildings” ¹

These do not only describe Holl and Corbusier’s work but also his own work. Woods’ project “Berlin Free Zone” comments on the reuniting of Germany after the removal of the Berlin Wall. Authorities are taking over the city and it is a symbolic, architectural gesture, almost an act of rebellion. It depicts the grid, ‘Cartesian’ buildings of Berlin, penetrated by a jagged, wild forms and voids called “Free Spaces” – which are *“free, in the first place of any predetermined meaning or purpose, for reasons of their own, choose to inhabit them. Difficult to inhabit because of their spatial configurations, they are an inner frontier that challenges conventions of every kind. You cannot move in with your own furniture”*. ² This idea of intersection of the Norm with the New is reminiscent of how Architecture is colliding with VR technology. VR is new and is seeking its functional / symbolic place within architecture. Or as a more literal translation, it is comparable to when a model of an existing building is imported into VR space and freehand drawn over/through by VR strokes – new devices, new meanings and purposes.



Berlin Free Zone (1990-91)

1 (Woods 2008)

2 (Myers, Woods, and Harries 2004)

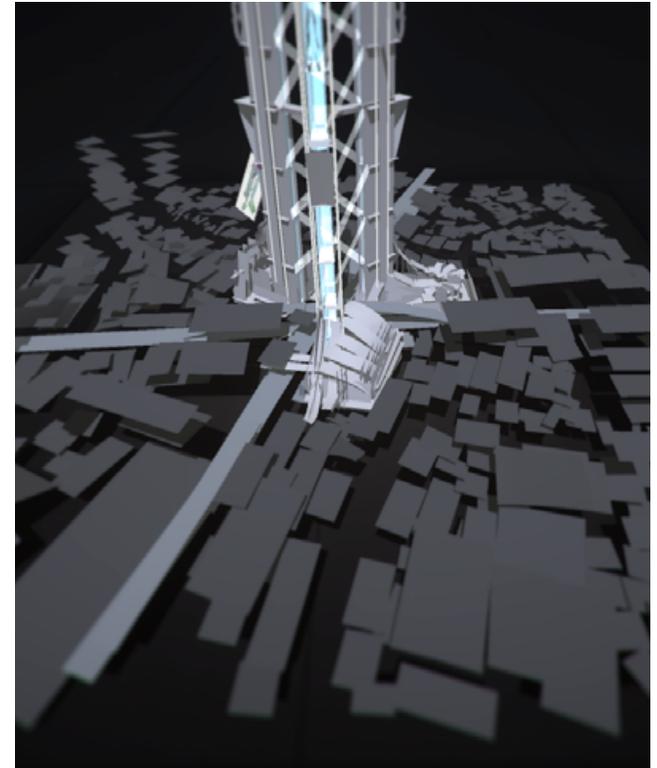
Besides commentary on politics of occupation (Berlin) and war (Sarajevo), Lebbeus Woods also depicts architecture's role in the wake of natural disasters – such as an earthquake. Woods sees architecture as something that must adapt to earthquakes, both before (Taiwan) and after (San Francisco). Architecture is reshaped so it “works with nature, not against it”¹. Lebbeus Woods ‘breaks’ architecture before nature does, creating a patchy pattern, a natural reaction to a natural action. Interestingly, this move is seen in his physical models, in Daniel Dociu’s digital concept art, and in VR drawing.



Terrain - Physical Model - Lebbeus Woods (1999)



Rooftops Digital Painting - Daniel Dociu (c.2005-2007)



Himpapawid Tower VR Drawing - Don Dimanlig 2016

1 (Myers, Woods, and Harries 2004)

2.3.3 - Post Apocalyptic - Katsuhiro Otomo

Apart from tragedies caused by nature, there are also tragedies caused by man. The Atomic Bomb that ended World War II caused not only radiation, but a cultural ripple – inspiring post-war influenced creations such as the monster movie franchise Godzilla, and the manga and animated movie, Akira. This manga by Katsuhiro Otomo started in 1982 depicted a very detailed Neo-Tokyo set in 2019.

Experimental weapons and battles destroy the city, in “disturbing scenes of annihilation visualized in such beautifully cinematic detail that they evoke a fully developed aesthetics of catastrophe and ruin” the ruined city in black and white looks very similar to Terrain by Lebbeus Woods.

But in between destruction is the very colorful Neo-Tokyo which is shown as a complex, dense city, where architecture, machine, and population are very much intersecting in large scales. This futuristic/dystopian depiction later becomes known as the Cyberpunk Science Fiction Subgenre - where it focuses on “high tech, low life” . ¹



Dark Cold higher areas, with active street level filled with lights (inset: similar Blade Runner concept)



Nuclear Weapon Explosion



Tokyo Destroyed / Detailing a city damaged in large scale

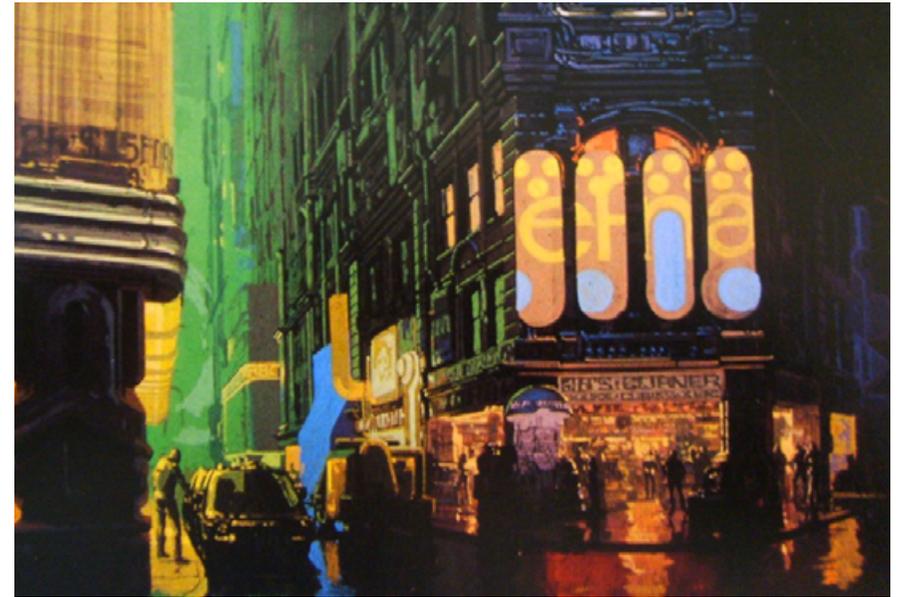
¹ (Ketterer 1992)

2.3.4 - Cyberpunk - Syd Mead

Taking advantage of the drawn (1982 manga) and animated medium (1988 movie), architecture and the urban scale can grow and grow – the same way paper architects took advantage of drawing and not building – and hopefully the same way virtual architects will take advantage of drawing in VR.

In 1982, (the same year Akira was first published) cyberpunk movie Blade Runner came out. Directed by Ridley Scott (Alien), written by sci-fi writer Philip K. Dick (Do Androids Dream of Electric Sheep?), with art from Syd Mead (Tron). Syd Mead's depiction of 2019 LA is similar to Otomo's 2019 NeoTokyo – A dense city with gigantic scale buildings, with the streets lit with neon signs.

Blade Runner, like Akira, shows how technology carries architecture, or leaves it behind. Not Only the technology within the film's story, but also the technology used in the making of the film itself.



Syd Mead Concept Art



Dark Cold higher areas, with active street level filled with lights (inset: similar Akira movie still)



Los Angeles 2019, Dark Skyscrapers, and monolithic pyramids
Screenshot from 1997 Director's Cut version

2.4 – Context: Artists Influence



Nativity Façade Photo by Aaron Chow



Detail Photo by Brianza2008

2.4.1

Grandeur - Antoni Gaudi

Spanish Catalan architect Antoni Gaudi's La Sagrada Família is significant because of its surreal effect. The portion finished before his death, the Nativity façade, is particularly fantastical – from the organic shapes adorning the entrance arches, to the great height of the spires, the influence this building has on my own VR work in terms of ornament and scale is comparable to the art of Kris Kuksi.



A Tribute to the Madness of Beethoven (2009)



A Heroic Abduction (2010)

2.4.2

Composition - Kris Kuksi

Kris Kuksi is an American sculpture/assembly artist. Kuksi's work blends politics and expression through blatant use of known imagery, dark with macabre overtones, and detailed to the point of madness

In VR drawing, I can quickly achieve a strong composition by using the symmetry tool – yet, if I don't also break into asymmetry, it becomes monotonous. The depth and detail achieved by Kuksi is in the layering of multiple pieces – in VR, these pieces are the strokes – simple when looked at individually, but creates a complex image seen as a collective whole.



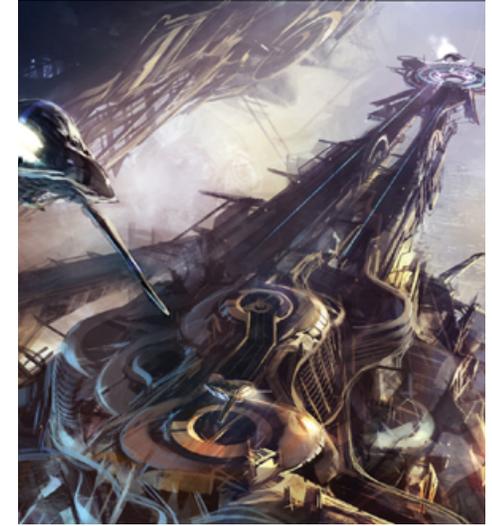
Concept Art c.2008-Present



Concept Art c.2008-Present



Fictive Museum (2005)



Third Mummy (2005)

2.4.3

Content - Daniel Dociu

Romanian Daniel Dociu is known for his work as chief art director of Guild Wars videogame franchise. His concept art is reminiscent of rough paintings but being digital, he has the advantage of adding existing textures of industrial, classical architecture into the landscapes / structures. Scale is also playful – where a structure in a painting can be intimate or colossal until a point of reference like a tree or people are found in the image.

In VR, one has the ability to view the work in infinite amount of angles – but that doesn't mean one should. Dociu's artwork has a defined focal point, an emphasized, bright and detailed part like the depth of field in a photograph.

2.4.4

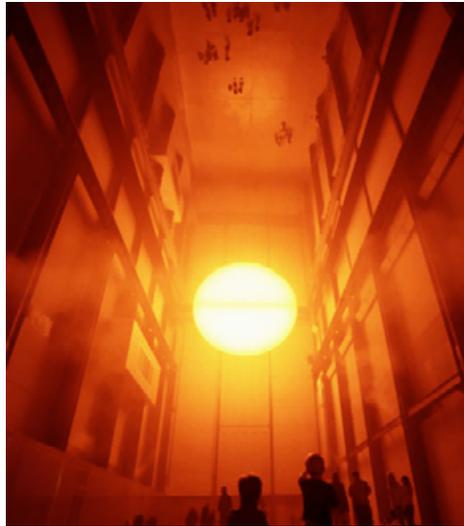
Economy - Sparth

Sparth, (Nicolas Bouvier) is a French art director and concept artist – recognizable in his work in videogames like Assassin's Creed and Halo. His fantasy paintings are futuristic. Sparth's use of broad strokes to compose the image is both brave and clever, as he defines the piece using a few passes of the brush, before effortlessly detailing the image.

The time one spends in a VR drawing can be tricky, a drawing can go from simple to complex with a few strokes. In VR, it is also emphasized because stroke conservation is also energy conservation – one does not want to be exhausted before finishing a piece.



Weather Project Photo by tkkiss03

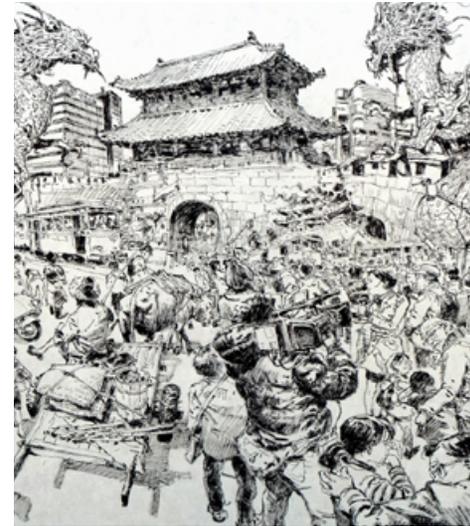


Weather Project Photo by Larry J. Clark

2.4.5 Emphasis - Olafur Eliason

Olafur Eliasson uses simple but effective arrangements of light and color in his work 'The Weather Project'. Tate Modern's giant Turbine Hall open space is fitted with a semicircle array of mono-frequency bulbs, a reflective ceiling, and mist - creating a bright, hazy, double height indoor space.

In VR, a solid light source is an easy way to control attention, bathe the piece in a cool or warm glow, and reduce many strokes into simplified silhouettes.



Chinese Town



Caravan Repair

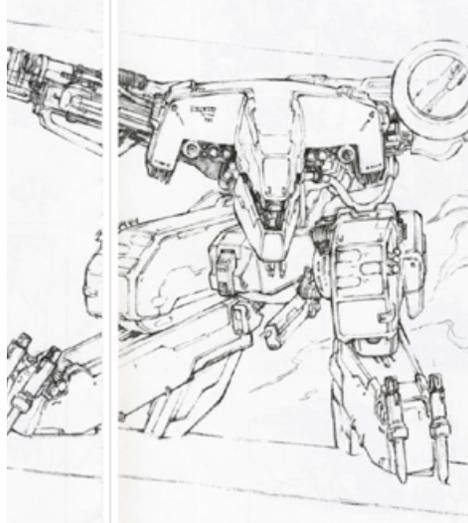
2.4.6 Continuity - Kim Jung Gi

Kim Jung Gi is a South Korean artist known for his hand drawn pen/brush collages. Most of his work involves active scenarios filled with people doing various activities. The detail and the composition of the final piece are incredible – but he is known for his process. His work is both final product and a performance – drawing directly in ink, from one character to the next until the piece is filled.

VR's final product, a 3D drawing isn't as established in the art world. However, Kim Jung Gi made his drawings both static and performance art. VR drawing's reliance on body movement, space usage, and it being a newly popularized method makes showing the process (usually a synchronized video of the VR view of the artist and a video of the artist).



Metal Gear 25th Anniversary art 2013



Metal Gear REX sketch Refine EXceed

2.4.7

Transformation - Yoji Shinkawa

Yoji Shinkawa is known for his art in Hideo Kojima's games: Metal Gear Solid and Zone of Enders franchises. The Japanese concept artist's designs start with ink brushes, and often finalized/coloured digitally. Then these ink drawings are basis of the soldiers, and robots (mechas) for the game. Shinkawa's work is detailed in some parts, and abstract and sketchy in others, the observer finishing the remaining image for themselves – the strokes showing haste and movement.

In VR architecture drawing, the looseness of not having snaps or reliable orthographic line settings calls for a creative, almost painting style. At the moment, the limited functions in VR drawing doesn't allow copy / pasting so the effort becomes similar to analog techniques – a repeating pattern like columns, or a series of roof panels become repeating, but different strokes. It becomes irregular and the irregularity becomes the style, almost.



Solatin (2005)

2.4.8

Imperfection - Inio Asano

Inio Asano is a manga (Japanese comic) artist. He is known for slice of life stories like Solatin, or psychological / personal stories like Oyasumi PunPun. His style includes stylized characters on top of realistically drawn backgrounds. Story involves complex relationships and penetrates human flaws. Story telling that plays with the chronological order is also an influence.

In VR, manga's influence isn't in the bare visual, but in the narrative. Similar to Shinkawa, irregularities become a style – and further, maybe flaws can be celebrated. Chronological mix up in VR architecture drawing can simply mean giving the element of time to a building – either by drawing past, present, and future versions overlaid or using the playback feature and watching the building draw itself – seeing which portions took longer or faster.



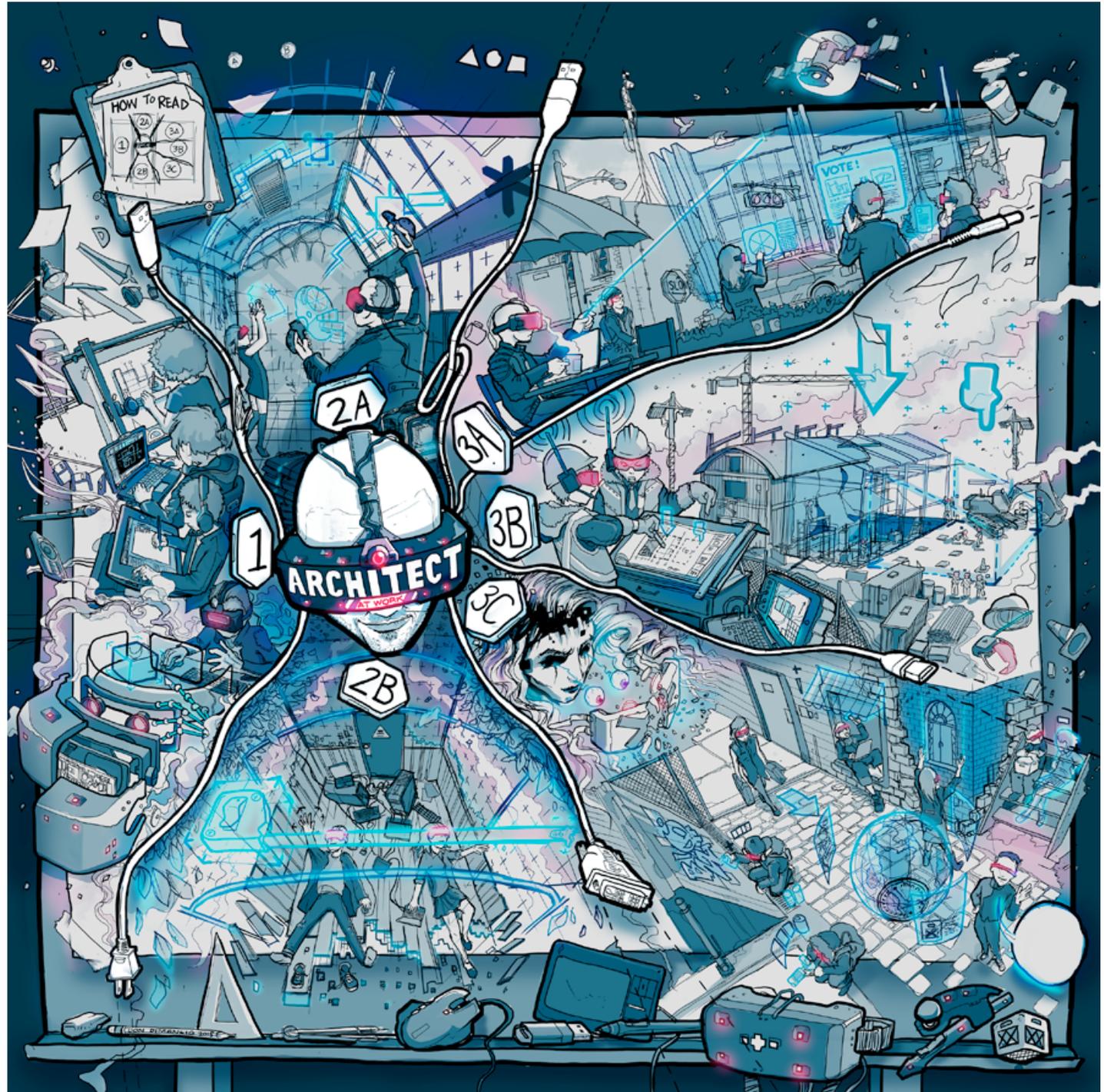
Oyasumi Punpun (2007)

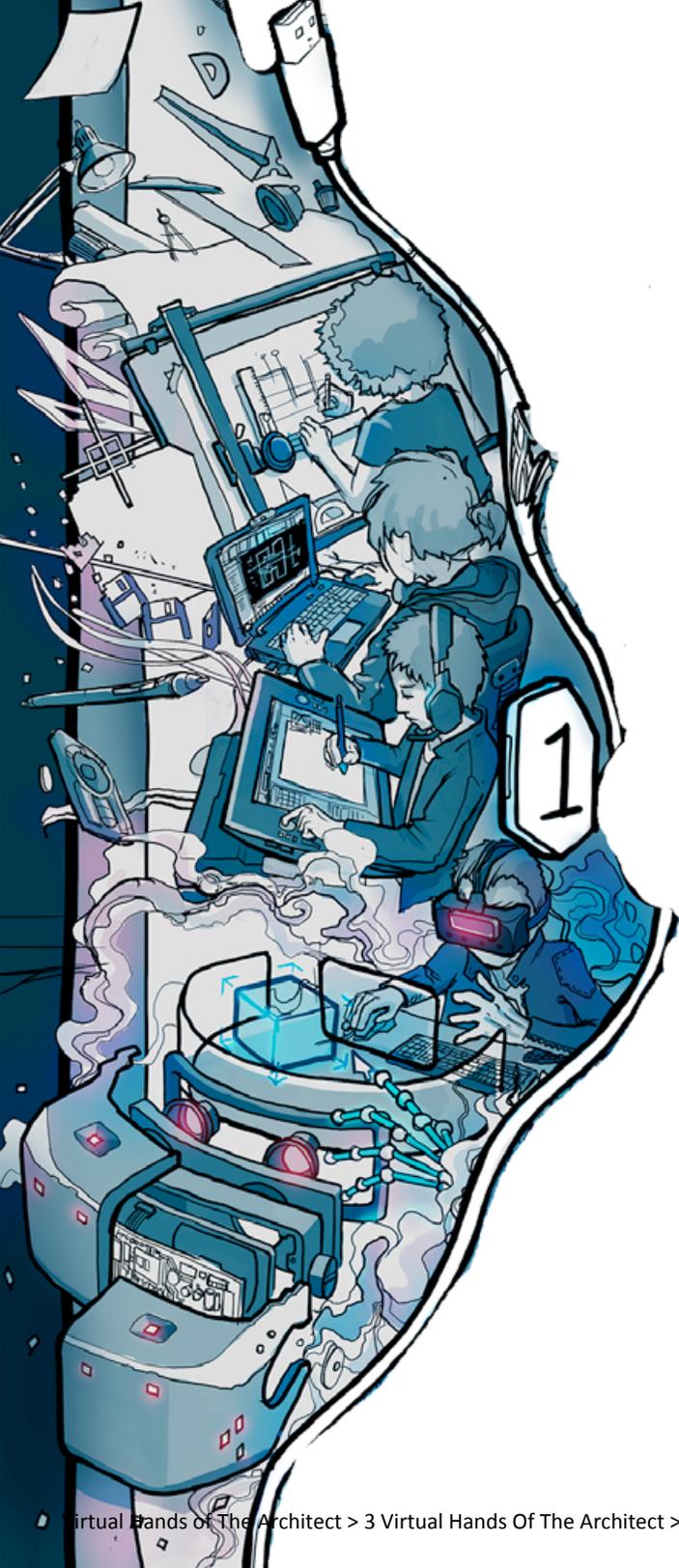
3 - Virtual Hands Of The Architect

3 - Virtual Hands Of The Architect

Virtual Hands of the Architect (VHOTA) Drawing is divided into six parts, indicating my idea of 6 “phases” of VR design related to architecture. The Architect’s head wearing the VR goggle and the 6 white cables divide the drawing. All six portions are drawn on one giant sheet mounted on a square drafting board, with the bottom pencil ledge having a couple of items on it, from left to right, the older drawing tools, to the latest. The sharpened drawing rock, a pencil, a triangle, a compass, a mouse, a USB stick, a drawing tablet, a tablet pen, a virtual reality goggle, a 3D wand/pen/controller, and a milk crate – symbolizing my own – device / method that comes out of this thesis. I also colored the physical world darker blues and grays (so that the physical world becomes the visual background), the VR projections a lighter cyan (so that the VR/AR visuals pop out), and VR device goggles and sensor auras pink (to indicate their locations, and how dense they are in an area as it goes into the predicted future). The use of Cyan and Magenta are also a nod to the use of Blue and Red as seen in 3D-glasses – stereoscopic imaging or Anaglyph 3D - where the two different colored lens are used to create the illusion of depth from the created from the combination of 2 images overlaid, one red and one cyan, usually combined with a regularly colored photo.

- 1 – Designing before VR
- 2A – Designing in VR/AR as a designer
- 2B – Designing/Experiencing AR collaboratively without leaving VR
- 3A – Public Viewing Testing
- 3B – AR Construction site
- 3C – Virtual World

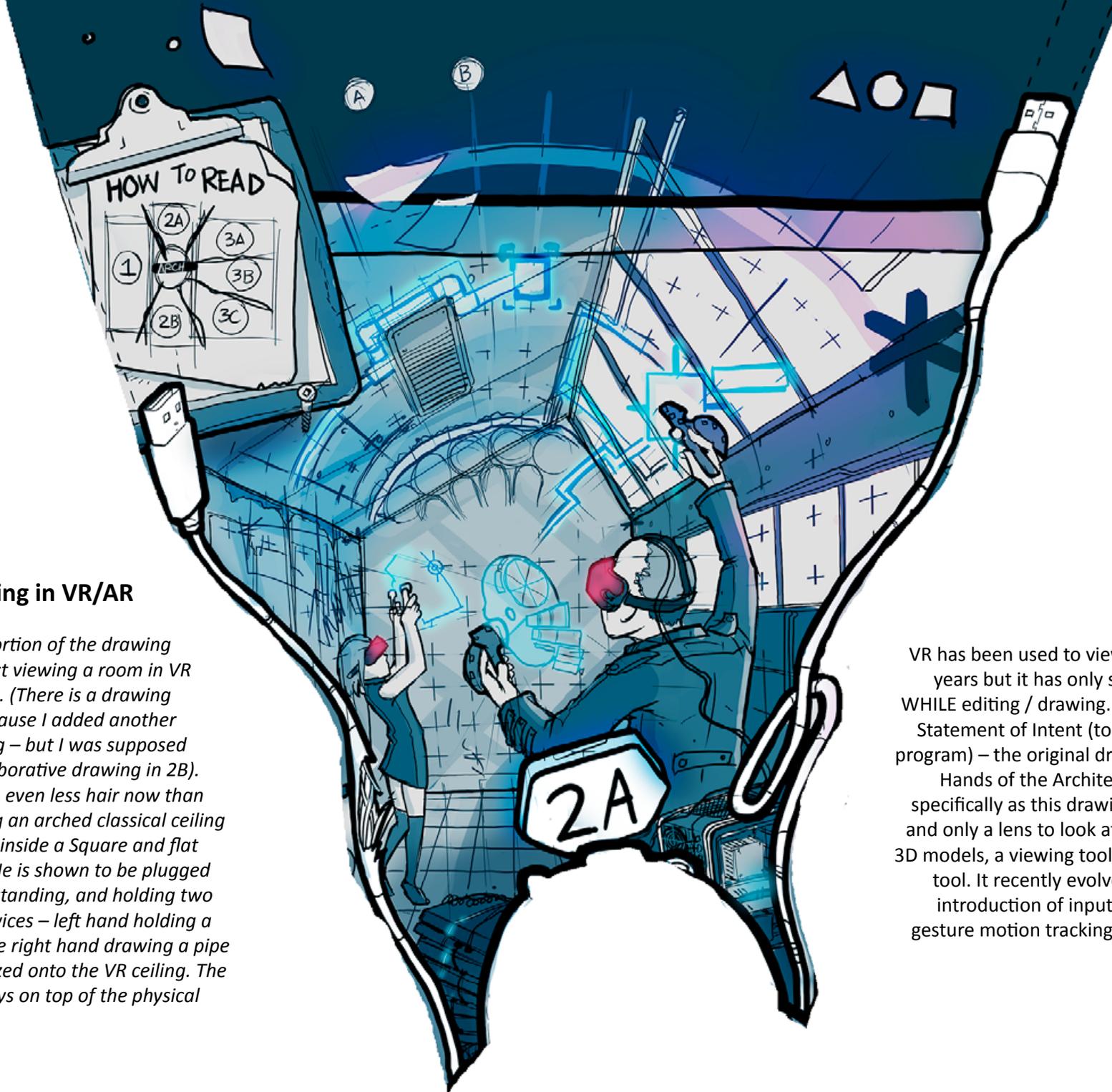




3.(1) – Designing before VR

The left portion of the drawing shows what architects (and designers) did before VR. It includes a draftsman (draughtsperson) on a drafting table with their tools shown flying around them. Let's call them the 'architect'. Next is the use of CAD (computer aided drawing/drafting/design), the architect (now with tied up hair) with a laptop and pixels and crosshairs flying around. Next is the architect (with even shorter hair) working on a drawing tablet screen: combining the comfort and familiarity of a pen but with the speed and digital advantages of a digital canvas and file. The last architect is using VR to view a drawing (also drawn for the viewer to see). It also depicts using a hand-motion detector so they can see their hand in VR with an exploded view of a typical modern virtual reality goggle.

If I were to expound on this portion, it will need a more detailed evolution of drawing, including drawing on site and onto parchment with scaled drawings. The evolution of drawing and drawing tools, I believe is on a logarithmic scale (as with all other technologies). With Virtual Reality as a very key catalyst as it introduces a different perspective into 3D models and movement. VR improved a lot over the past year and is steadily growing. By the time this thesis starts and until I submit it, the technology has already evolved rapidly that a continuation / amendments might be needed immediately after.



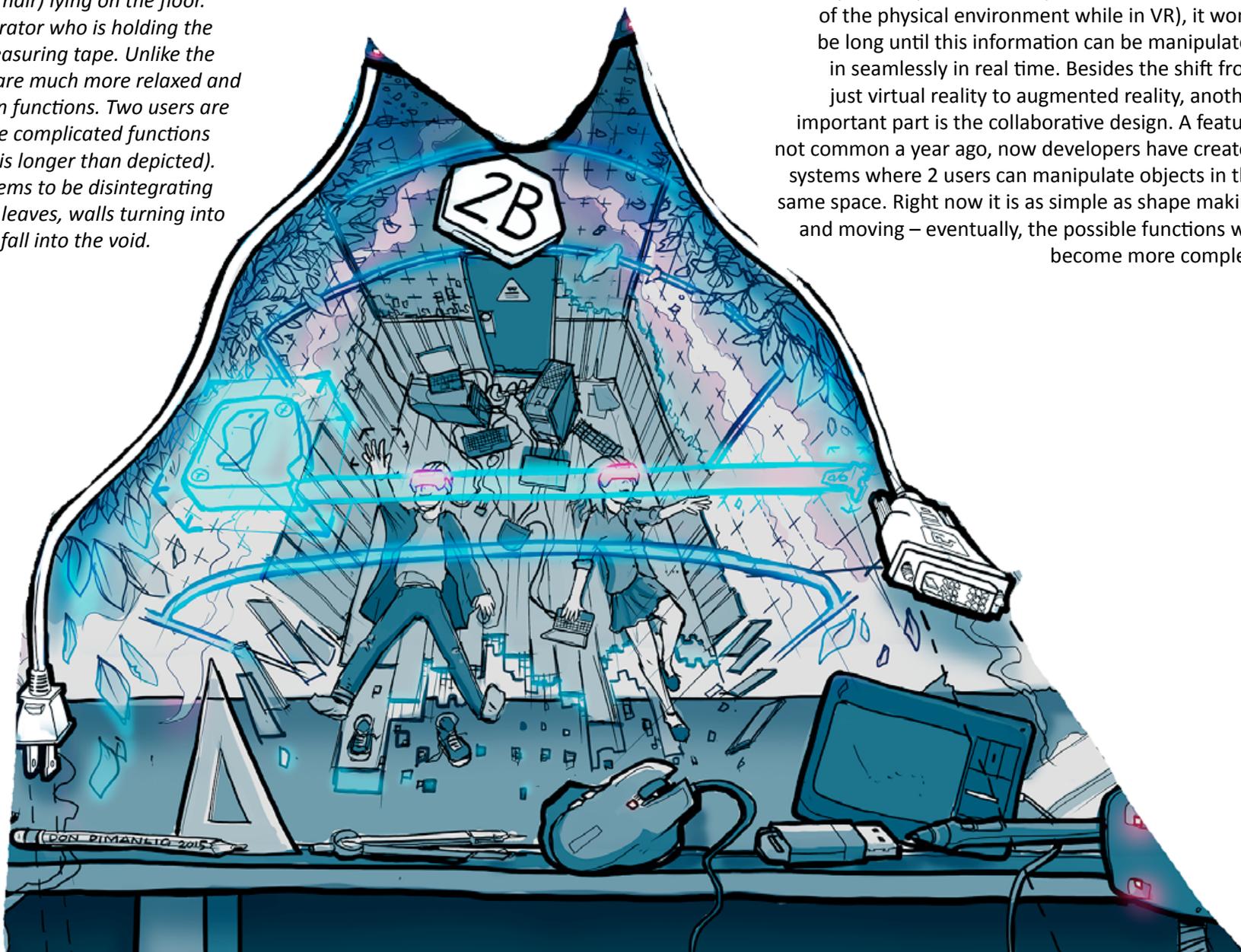
(2A) – Designing in VR/AR

The top middle portion of the drawing shows an architect viewing a room in VR and drawing on it. (There is a drawing mistake here, because I added another character drawing – but I was supposed to introduce collaborative drawing in 2B). An architect (with even less hair now than before) is drawing an arched classical ceiling in VR while being inside a Square and flat industrial room. He is shown to be plugged into a computer, standing, and holding two hand drawing devices – left hand holding a VR palette and the right hand drawing a pipe path as it is digitized onto the VR ceiling. The VR/AR just overlays on top of the physical room.

VR has been used to view architecture for years but it has only started to be used WHILE editing / drawing. When I wrote my Statement of Intent (to enter the M.Arch program) – the original draft for The Virtual Hands of the Architect, was expressed specifically as this drawing. VR was young and only a lens to look at architecture and 3D models, a viewing tool, not as a drawing tool. It recently evolved because of the introduction of input devices like hand gesture motion tracking, 3D wands, pens, etc.

(2B) – Designing/Experiencing AR collaboratively without leaving VR

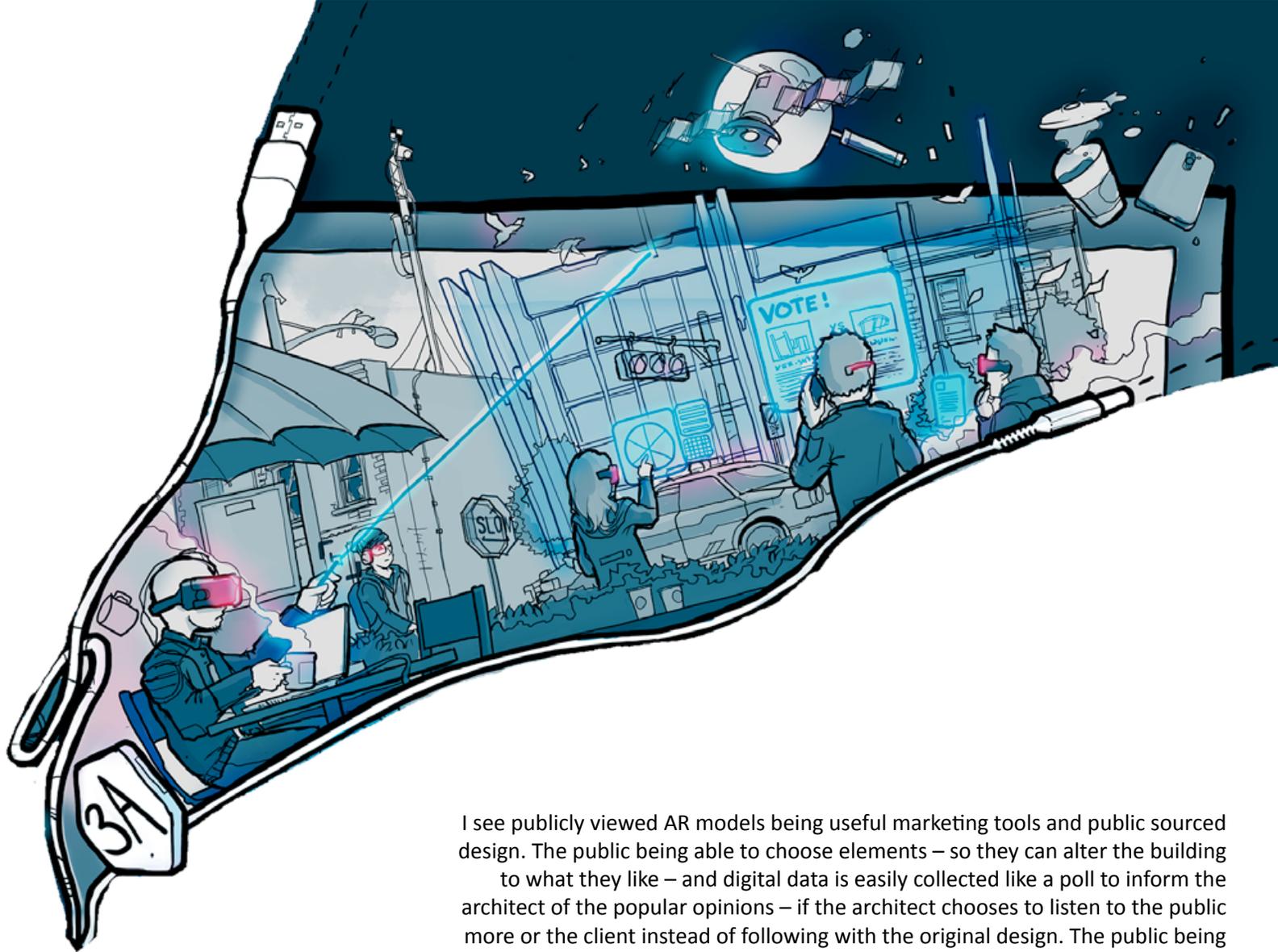
The bottom middle portion of the drawing shows the architect (now with no hair) lying on the floor. He is shown with a collaborator who is holding the other end of the virtual measuring tape. Unlike the formal format of 2A, they are much more relaxed and working together on design functions. Two users are helping each other on more complicated functions (maybe that measure tool is longer than depicted). They are in a room that seems to be disintegrating – with ceilings replaced by leaves, walls turning into clouds, and floors that are fall into the void.



Unlike 2A where The VR/AR just overlays on top of the physical room, I depict VR/AR here to be able to adapt and alter the visual based of the physical world. With technologies such as front facing cameras and the chaperone system (where you can still see outlines of the physical environment while in VR), it won't be long until this information can be manipulated in seamlessly in real time. Besides the shift from just virtual reality to augmented reality, another important part is the collaborative design. A feature not common a year ago, now developers have created systems where 2 users can manipulate objects in the same space. Right now it is as simple as shape making and moving – eventually, the possible functions will become more complex.

(3A) – Public Viewing Testing

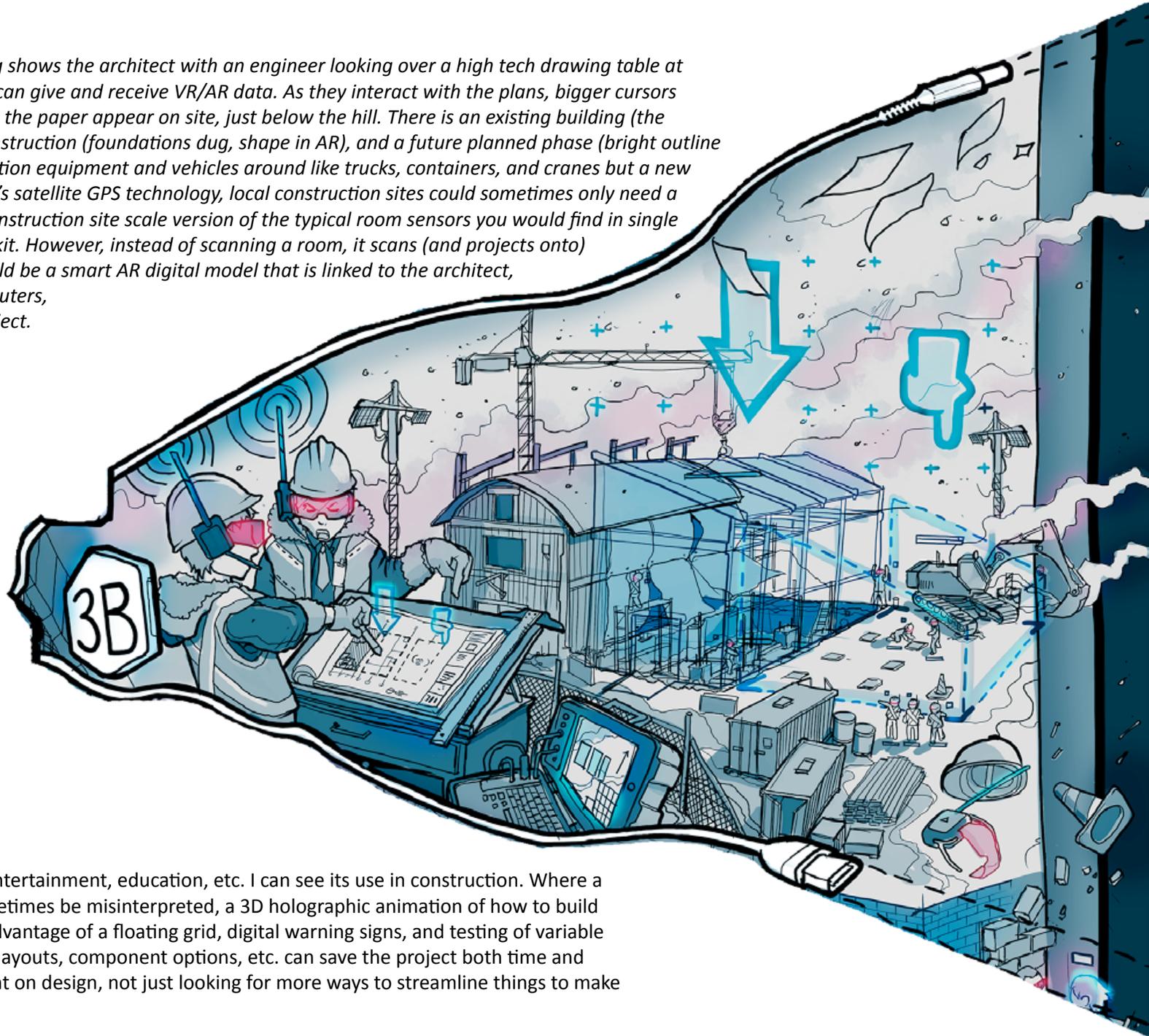
The upper right portion of the drawing shows a public viewing and testing. Much like software, architecture is screened with pre-phas and beta versions, before the final version is released. Here, the architect is shown sitting with a cup of coffee at a sidewalk café table, operating from a laptop and pointing at an AR version of a building on the proposed site. Above the scene, there is a satellite in high orbit. This shows how a global positioning system (GPS) will be integrated into geo-locating and positioning these digital models into the world. The architect's computer, the AR building, the satellite and the bystanders' AR devices are all connected into one big network. In this depiction, AR goggles and glasses are commonplace just like we have camera-phones and music headsets today. We can see one user on the right not paying attention to the building, but still wearing the device – an indication that one day, people will be comfortable with the device whether they are in active use or merely wearing it for later. Next is a woman passerby who has access to her own control panel via her device. The public is allowed to set different colors/themes to the building. Beside her is a man who is voting on the designs.



I see publicly viewed AR models being useful marketing tools and public sourced design. The public being able to choose elements – so they can alter the building to what they like – and digital data is easily collected like a poll to inform the architect of the popular opinions – if the architect chooses to listen to the public more or the client instead of following with the original design. The public being able to vote on designs would be another function should multiple proposals (e.g. competition) be available for the same given site. It would be as simple as flipping the TV / Radio channel and you would see a different visual. Each person can flip it as they wish and can see it change from their own point of view. I imagine some of these models can be public for a few hours, (e.g. a new public square statue) to even a few weeks so that the public can truly experience and choose what they enjoy (e.g. a whole sidewalk renovation for instance).

3.(3B) – AR Construction site

The middle right portion of the drawing shows the architect with an engineer looking over a high tech drawing table at a construction site. This drawing table can give and receive VR/AR data. As they interact with the plans, bigger cursors representing what they're aiming at on the paper appear on site, just below the hill. There is an existing building (the dullest blue/gray), a building under construction (foundations dug, shape in AR), and a future planned phase (bright outline / highlight). There is the usual construction equipment and vehicles around like trucks, containers, and cranes but a new addition is the laser tower. Unlike in 3A's satellite GPS technology, local construction sites could sometimes only need a localized solution. Laser tower is the construction site scale version of the typical room sensors you would find in single user commercial virtual reality goggle kit. However, instead of scanning a room, it scans (and projects onto) a construction site. This projection would be a smart AR digital model that is linked to the architect, the engineer, the drawing tables, computers, and all construction workers of the project.



Augmented Reality has been used in entertainment, education, etc. I can see its use in construction. Where a 2D printed drawing of a detail can sometimes be misinterpreted, a 3D holographic animation of how to build a detail can be clarifying. Adding the advantage of a floating grid, digital warning signs, and testing of variable things such as paint swatches, parking layouts, component options, etc. can save the project both time and money, so that more effort can be spent on design, not just looking for more ways to streamline things to make them cheaper.

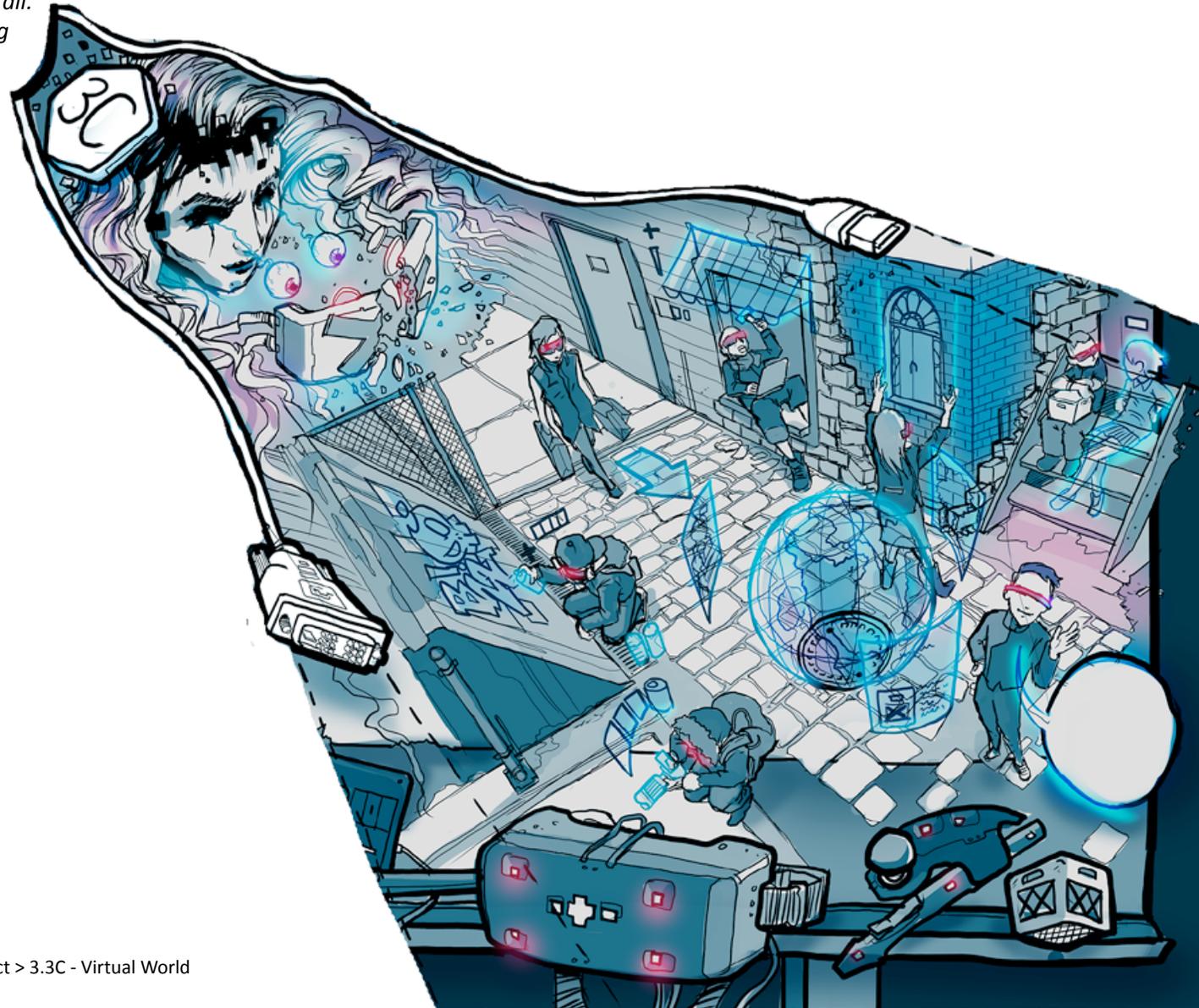
3.(3C) – Virtual World

The bottom right portion of the drawing shows what I see as the Virtual World. Our imaginations are a virtual world in our heads. The Internet is another virtual world. The overlay of digital models and images on our physical world is another virtual / augmented, or combined world. First we see a head figure with long hair and a mask and eyes popping out of its sockets and breaking the virtual reality goggle – my symbolism of us breaking the barrier of what the eyes see and what the goggles see. The head overlooks a street with many characters – all with VR/AR goggles. There is a girl shopping with AR waypoint arrows on the ground below her. A relaxing boy sitting on a window drawing an awning above him. A girl drawing a window above a destroyed corner of a building. A boy sitting on a staircase talking to an AR girl – is she AI? Or is she a hologram of a friend on a phone call from somewhere else?

There is an AR globe projected in the street, seen by all. It has advertisements. A young man is spray painting graffiti without actually causing fumes or physical vandalism on the wall. Another is sitting taking photos using AR with an interface of a traditional DSLR camera but the advantages of not having to carry one. Lastly, there is a man looking at the viewer of this drawing.

This stage of the role of Virtual Reality in architecture and design deals with the more figurative. We start to question - if the simulation is strong enough, does it need to be built? Or is the digital presence as strong as a physical one and it can stay in the digital realm? Tom Goodwin made a good point saying “Uber, the world largest taxi company, owns no vehicles. Facebook, the world’s most popular media owner, creates no content. Alibaba, the most valuable retailer, has no inventory. And Airbnb, the world’s largest accommodation provider, owns no real estate. Something interesting is happening.”¹ Architecture has always relied on – Architecture, the physical built object that is the building. It is interesting to wonder what place Virtual architecture would take in the grander scheme of our current digital environment.

¹(Goodwin 2015)



4 - Process

4 - Process

4.1 Colloquiums - Before VR Hardware

Over the course of this thesis, in developing towards the final project, there have been a number of case studies which have been focused on acquiring skills and familiarity with new software and VR technology. These are what I learned in the process.

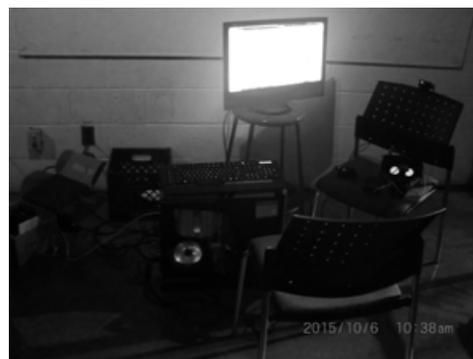
The thesis methods and goals themselves have been morphed by hardware and software availability. In the beginning stages of the thesis, I had to decide between AR and VR. Augmented Reality Goggles would offer the ability to see both digital space and physical space overlaid on top of each other, however, the rarity and cost of AR goggles was punitive. I decided to choose the more financially accessible, Virtual Reality hardware and focus on what I can achieve with the more controlled medium.

Even with the success, popularity, and reliability of the Oculus Rift, I chose the HTC Vive instead. It has two main advantages being: motion controllers, and room scale tracking. The controllers give me the capability to draw in VR, rather than just viewing in VR. The bigger tracking space allows me to make larger 'drawings'.

I learned a lot from demonstrations. What works and what does not. (Progress detail in the appendix / inside one of the games?). The early demonstrations of importing an architecture model into a game engine and viewing it in VR proved effective in engaging an audience. It was also an early lesson in performance issues like framerate drops (also known as lag) linked with each model's relative complexity.



VR Demo



Colloquium 1



Colloquium 2



Colloquium 3

Colloquium 1 focused on clarifying that the goal is showing the advantage of VR in terms of simultaneous input and output, designing and visualizing at the same time. (Representation chart). However, with the speed at which hardware and software companies are developing VR, it no longer made sense to have a thesis focused on creating / conceptualizing a program that allowed me to collaboratively design architecture. Each function needed make Phase 3A,3B,3C of the drawing Virtual Hands of The Architect in reality is either already commercially available or in the process of being made by developers. It is merely a matter of having these functions completed and combined. I will leave that up to them.

Colloquium 2 taught me how to make AR models. Using a tablet, this gave me the ability to add an AR image (3D model) "floating" on a physical printed image. The advantage is the portability without needing a full PC/VR setup. The disadvantage is one still needs the right app and compatible mobile device can see them. The ensuing discussions reminded me that an experimental/observational angle would show more of VR drawing capabilities as well as mine own.

After Colloquium 3 I considered "Why not view all this information in Virtual Reality?" I proposed placing the thesis in a videogame environment and have the viewer read and view my work in VR.

In developing this idea I decided it would be the Carleton University Architecture Building. "As we go further into the building, we should go deeper into your imagination" ¹

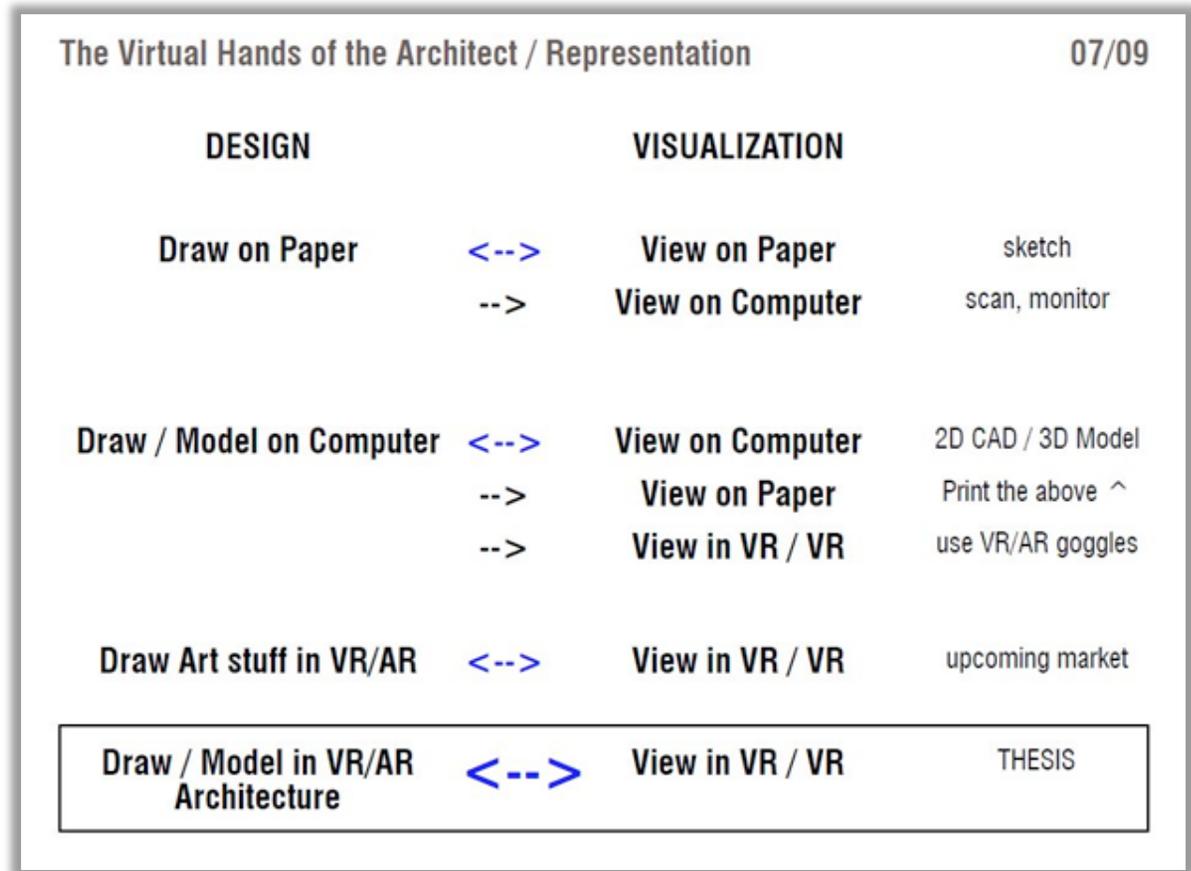
¹ (Voordouw 2016)

“...the peculiar disadvantage under which architects labour, never working directly with the object of their thought, always working at it through some intervening medium, almost always the drawing,

while painters and sculptors, who might spend some time on preliminary sketches and maquettes, all ended up working on the thing itself, which, naturally, absorbed most of their attention and effort. I still cannot understand, in retrospect, why the implications of this simple observation had never been brought home to me before. The sketches and maquettes are much closer to painting and sculpture than a drawing is to a building, and the process of development – the formulation – is rarely brought to conclusion within these preliminary studies. Nearly always the most intense activity is the construction and manipulation of the final artefact, the purpose of preliminary studies being to give sufficient definition for final work to begin not to provide a complete determination in advance, as in architectural drawing. The resulting displacement of effort and indirectness of access still seem to me to be distinguishing features of conventional architecture considered as a visual art, but whether always and necessarily advantageous is another question”

- Robin Evans ¹

1 (Evans. 1997)



Earlier in the Thesis, this chart explained what the research is trying to achieve, to enable, and then later to study designing AND viewing in VR - Simultaneously. Later, the thesis focused not on enabling this, but rather, what can be drawn and imagined with the now-available technology.

4.2 VR Hardware - Drawing Tests

This is not my first experience in VR, however, the immersion is still affecting my senses – easily forgetting the boundaries of the physical room, and trusting things in virtual space.

Summer started with the arrival of my Virtual Reality equipment. My computer, as well as the basement room it sits in, all had to be upgraded and modified to be VR ready.

After watching videos of developers using Google Tilt brush for more than a year, I developed “muscle-anticipation” (future tense “muscle-memory”) for the options. I am moving with full arm and body motions. I didn’t realize, however, the stamina required for prolonged drawings. But I am finally able to step inside my canvas. The paper is no longer a rectangle; the screen is no longer so many pixels tall by so many pixels wide.

I tried testing the different hypotheses from before I had the VR hardware. I thought doing straight lines would be difficult due to the parabolic way our limbs swing, but surprisingly I found it easy to do them – almost as stable as on a flat surface. However, drawing in 3D space tends to make the user expect volume to their drawings – but Tilt Brush is a mesh drawing program, not a 3D sculpting program. Drawing solid forms takes a bit of creativity – or at least, a lot of strokes. Other people who tried my VR setup said the same thing, at times, they want solid / volumetric tubes to come out of the brush like toothpaste, not just flat, ribbon-like strokes. Luckily, solid-sculpting / carving is available in other programs such as Sculpt VR, PaintLab, Kodon, etc. Modbox is a Sandbox-type VR program, which means you can build whatever you want from the available parts and tools, and then play with the forms afterwards. A few minutes in edit mode and I see the many disadvantages of VR modelling, such as your own body’s reach, your shaking accuracy, and many other features one is used to having in non-VR 3D modelling software such as Sketchup, Rhino, Revit, etc. What works great is the intimacy the user has with the model, as it is more hugged between the users’ arms and not just viewed on a screen. The VR immersion also quickly fools one’s perception, as I found myself immediately leaning on a table I made in VR right after building the room around it, then stopping to rest.

Demonstrations have showed me how fast people pick it VR drawing. VR drawing and modelling really shows a speedy learning curve, and near instantaneous viewing results. However, VR drawings are new, and therefore, also need new forms of exporting files. What is the final result? The model? Snapshots of the model? Video playback of the drawing? I consider the whole drawing a performance, being so closely related to the body, that a video of the person drawing it is essential. There are many ways, but currently their lacks agreed on what file format to use. Unlike how architecture will always have the tried and tested floorplan and model, a VR drawing will eventually need to find its ‘reliable’ output form.



HTC VIVE VR Headset /
HMD (Head Mounted Display)

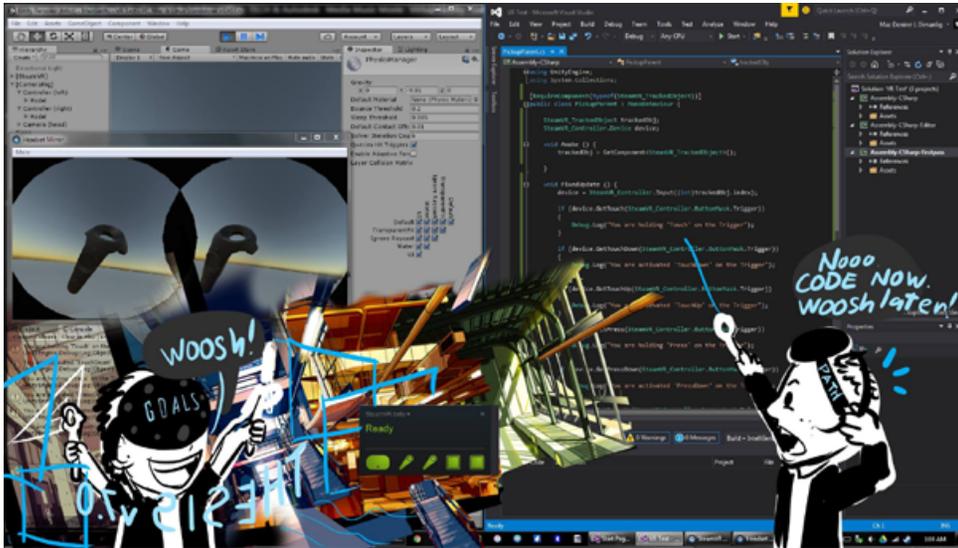


HTC VIVE / STEAM VR
Box and Components

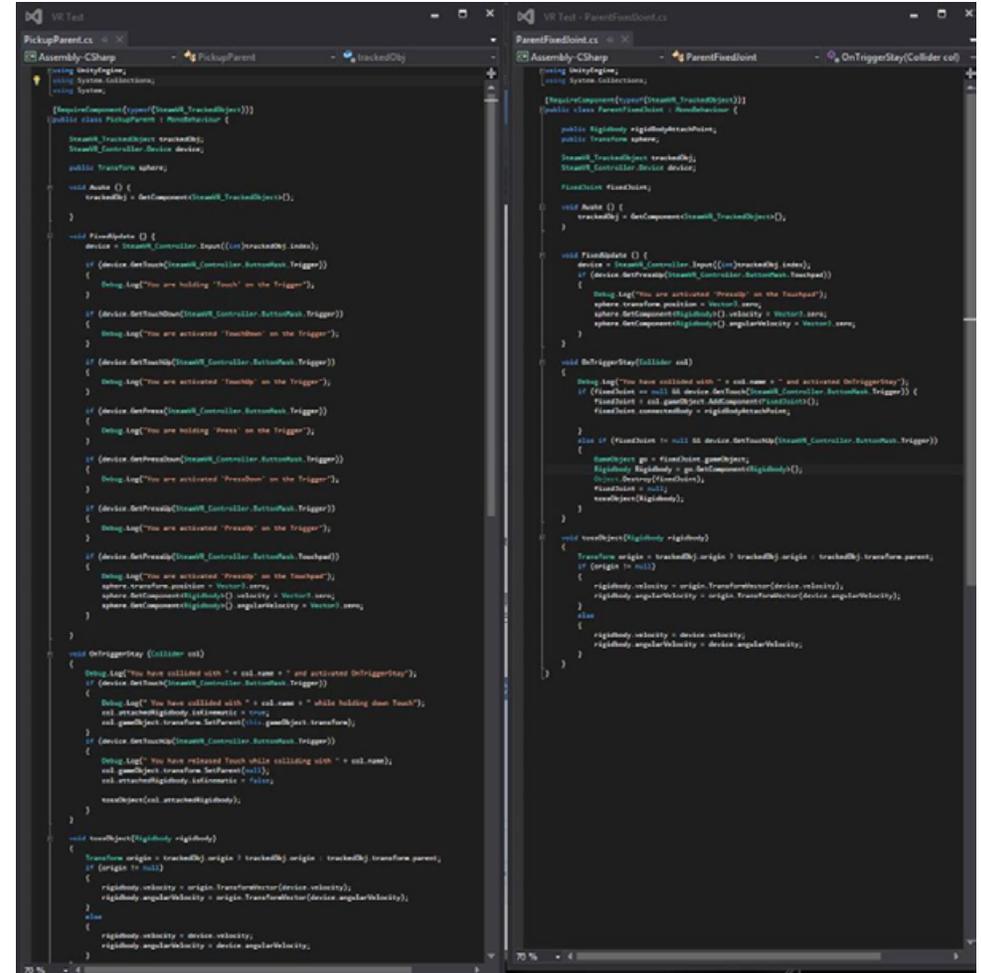
4.3 VR Game - Coding / Modelling

Knowing that I will be making an interactive VR space (I simply call it a 'game', even though there is no win/lose mechanic), I learned a bit about coding. These basic codes allowed me to put my VR view into a game using Unity (gaming software), as well as taking advantage of using controllers. While I was learning about other games' creative / game functions, I was thinking of which ones I need to learn and expand upon. Functions such as teleporting (displacing one's point of view from one location in VR space to another, instantaneously), or manipulating not just props in the space, but the walls and floors themselves (being able to modify the environment, what would've normally been fixed and immovable) – as architect manipulating the space around him/her.

Eventually, I have created an empty version of the Architecture Building. This acts as a walkable-thesis. After going into a certain level of detail, however, I noticed a slowdown in certain areas. I knew then that the building needed to be optimized. I chose to postpone further development of the project background (Architecture Building) and proceed to conduct a series of drawing experiments.



Trial and Error
Unity + Visual Studio



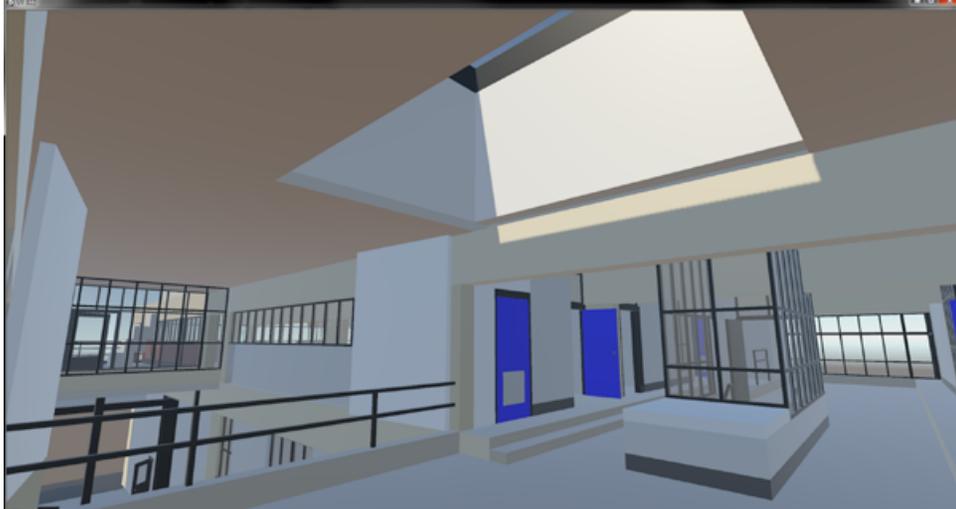
2 Different Scripts for Similar Function
Picking up and throwing a ball in VR



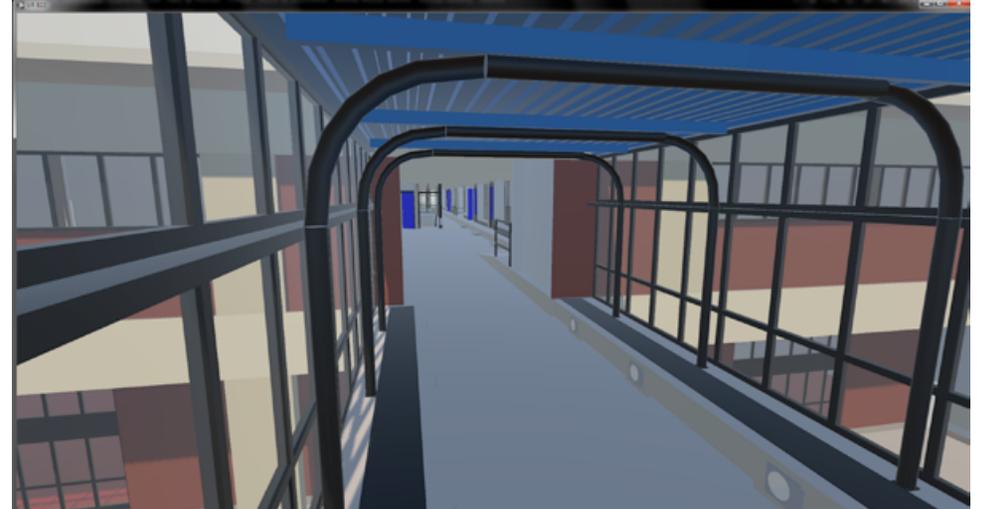
Game Build v36 Screenshot
Front Entrance



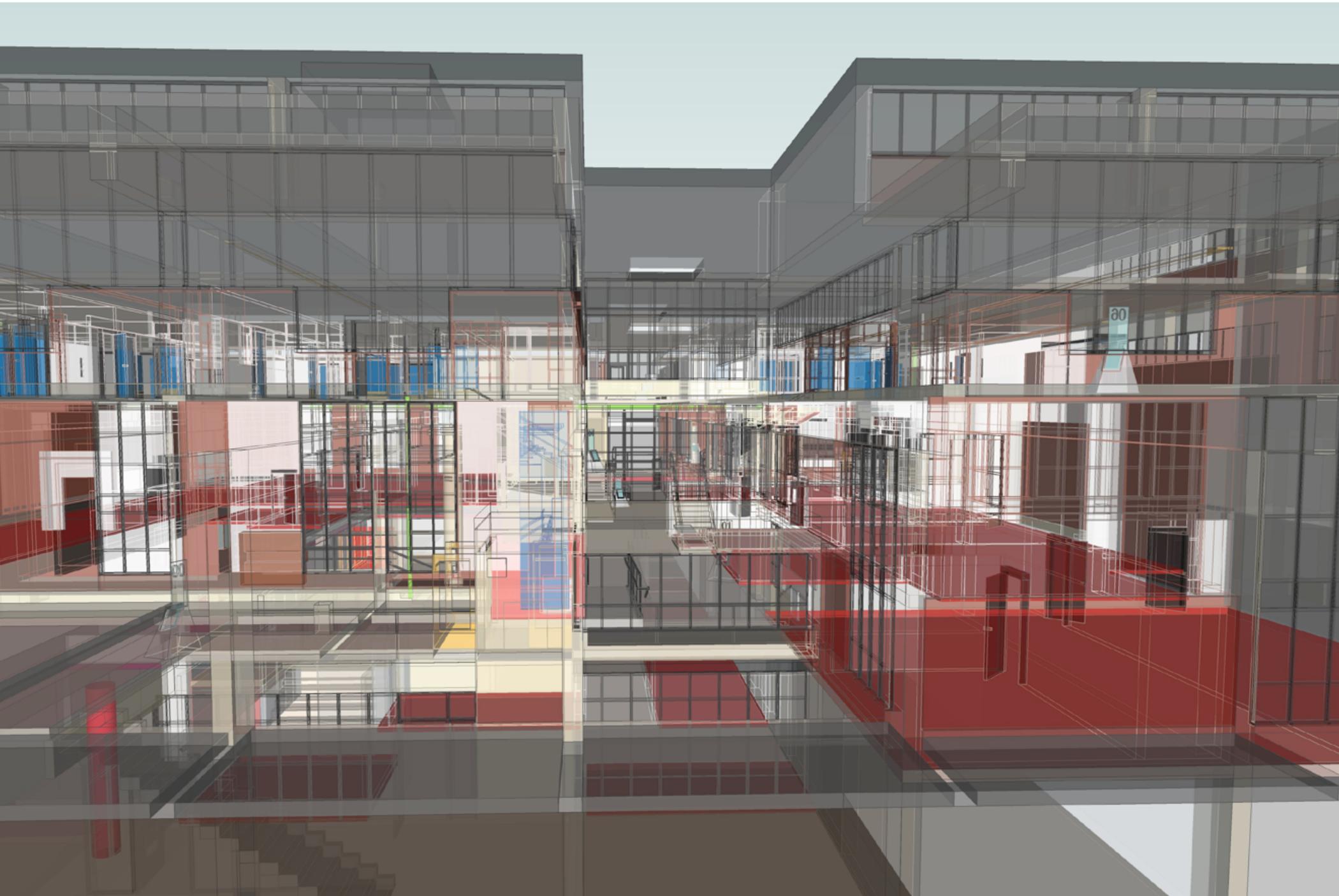
Game Build v36 Screenshot
In Front of the Pit / Lower Street



Trial and Error
Upper Street / Skylight



Trial and Error
Bridge to Mackenzie Building



X Ray View of Sketchup Model of Building 22
to be imported to Unity to make a game

4.4 - VR Annotated Instructional Video



VIDEO:
<https://youtu.be/sX114t7a7Ms>

The video (and more importantly, the annotated screenshots) of this drawing are here to showcase how to draw some basic architecture geometries and effects.

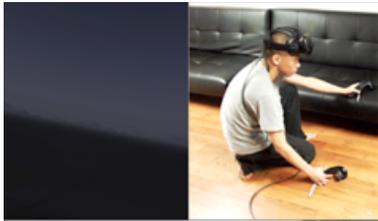
4.4.1 - How to Layout

4.4.2 - How to Terrain

4.4.1 - How to Mass

4.4.1 - How to Detail

4.4.1 - How to Effect



1. Before going into VR, establish the **PHYSICAL** boundaries of the room, clear furniture and other obstacles



1. Choose your **TEXTURE** for the terrain brush. Thick Paint for rough, Oil for medium, and Duct Tape for smooth



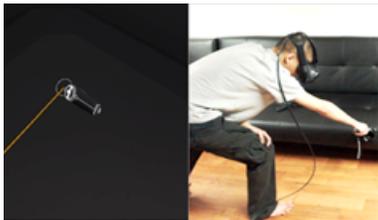
1. Set the brush to **FLAT**, and activate the **STRAIGHT EDGE** tool, congratulations, you now have the basic architecture VR brush



1. To draw **STAIRS**, fix your brush width/radius and stagger vertical and horizontally tilted strokes, then space evenly. Practice.



1. Need emphasis? An intense **LIGHT SOURCE** will shift their focus, and almost entirely make (or break) the drawing.



2. Besides the Chaperone system, it also helps to draw your own **PERIMETER** in VR (before teleport / scale / rotate update)



2. Draw the **MAJOR** features of the land. Shape the earth using body motion and full swings, plant foot as needed



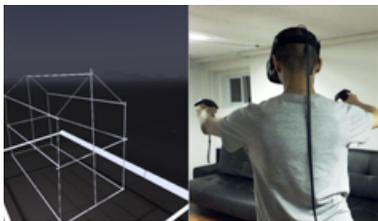
2. Establish the shape of the building by drawing the **LARGE PLANES** first, take as many attempts as needed for the big ones.



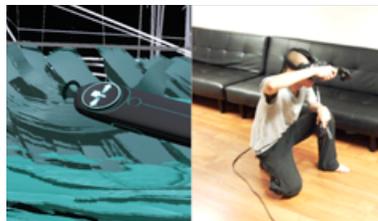
2. **DETAIL** the building further with the thinnest planes- for railings, pipes, grass. Vary between straight and tapered.



2. Give your drawing extra life by adding moving **ELEMENTS** such as fog, snow, streaming lights, thunder, fire, etc.



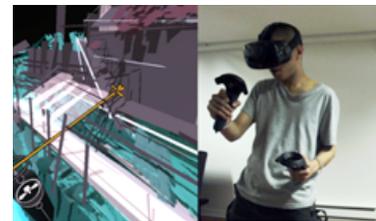
3. Draw the **WIREFRAME** (3D outline of the building and area) using a narrow brush and with light or dark color (depends)



3. Get in close and detail the **MINOR** features of the earth, alternate the brush size and angle to keep it interesting.



3. Further detail the building by placing the **SMALLER PLANES** (or strokes) around - mind their lengths and angles.



3. **GLASS** can be done using the Highlighter brush - (temporary Opacity alternative). Use with caution, don't over-stack/brighten



3. **PEOPLE / CROWDS** can be emulated by a combination of the splatter brush and smoke brush, spaced alternately.

4.5 - VR Conventions / Terms and Techniques

These are terminologies that one needs to define in order to communicate with other VR artist and the growing VR audience - a loose language for now, to describe certain setups and configurations that may (or may not) only happen in VR space.

From the instructional video from the previous section stems some techniques worth repeating. These methods are not necessarily exclusive to VR, (as they can be emulated with 3D modelling as VR is just 3D modelling with access to your own view and hand controls) but rather methods that VR can take advantage of. These are not all the techniques and there will be more to learn in the future.

4.5.1 - Layout Terms/Tech

4.5.2 - Terrain Terms/Tech

4.5.3 - Mass Terms/Tech

4.5.4 - Detail Terms/Tech

4.5.5 - Effect Terms/Tech



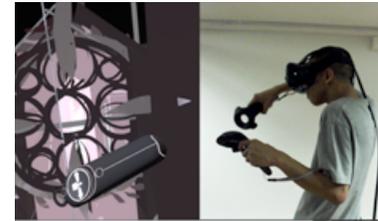
PHYSICAL BOUNDS
the physical limitations of the current room the VR system is set up in.



TERRAFORMING
Manipulating Terrain in VR is fast and easy take advantage of it



DRAGGING
Long lines require a form footing, and flexible reach. Straight Edge optional.



FREE HAND DETAILING
feel free to take full advantage of motion controls, get close, and use gestured lines



BLINDING
for light (and color) to bleed (and wash), place it directly behind thin lines



CORNER PLOTTING
Technique of drawing the boundaries in VR (before teleport / scale / rotate update)



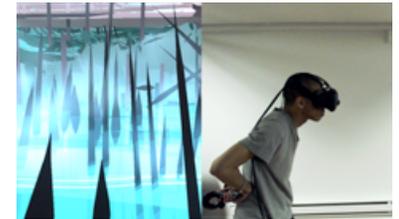
SCOOPS / SCRAPES
Curvy Strokes for hills, waves, arches, etc need a brisk wrist flick.



PATCHING
To create a layered, tiled/scaly effect, use straightedge with fast and small strokes



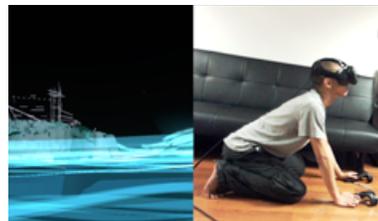
STICKING
Similar to patching, except narrower, longer, and perpendicular to base surface



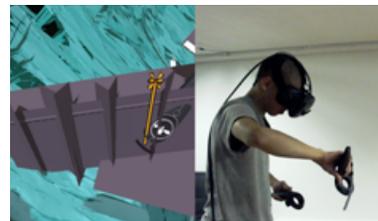
FORCED FADING
Naturally, far objects fade/blur away, but it can be faked using the smoke brush



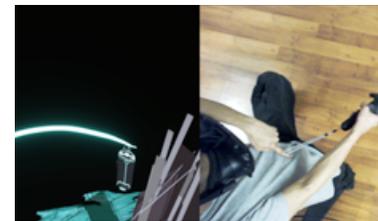
WIREFRAMING
the stick outline VR sketch of the building Can be as detailed or loose as needed.



SINKING
in VR, one can easily reposition themselves into different heights from the horizon



SHADOW SHAPING
A method of showing depth and shape by only letting angle difference create shadow



BODY COMPASS FOR CIRCLES
use the mirror tool, use your body as the center, pull strap, and draw a fast arc



PLAYBACK
Load your VR drawing from the SketchBook menu after Saving, and watch it draw itself

4.4 - VR Drawing - Videos / Analyses

The VR experiments consists of different VR drawings, each acting as sketches / doodles that I will study while taking observational notes of the work during and after the VR process. Each drawing will focus on a different aspect of architectural drawing. VR drawing of lines, VR drawing of boxes, VR drawing experimenting with hatching/shading/coloring, VR drawing comparing depth-making techniques against other mediums, VR drawing describing density and what or how one might go about to make a space feel heavy, as opposed to drawing on one flat surface.

The VR project covers 10 buildings I have designed in the School of Architecture. That is one building per semester while studying at the Azrieli School of Architecture and Urbanism. The purpose is to see how my old designs translate to different production methods – Using new technology to explore old ideas. It considers how the new techniques can reveal interesting ideas about the old designs. My familiarity with my own work will make it easy for me to compare not only the building design, but also the design principle that went into them. This creates a fast and substantial pool of information from which I can learn about VR drawing as each of these will be analyzed and techniques will be gathered into a cohesive, comparative chart

VR Drawing Playlist

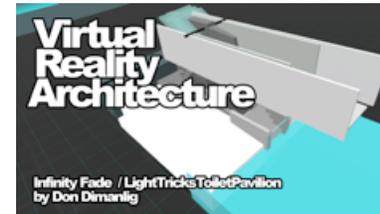
https://www.youtube.com/playlist?list=PL_vHEHrWgWQh3QOySv_GfyU2zTQhIJ5EQ



Photoshop vs Virtual Reality
https://youtu.be/HzZp_HbNOMU



1F - Mining Facility
<https://youtu.be/LkgyUR-xPcw>



2F - Infinity Fade
<https://youtu.be/eIKMFgF-80I>



3F - Bluesphemy
https://youtu.be/Zi8JpIVC_M



4F - The Gates
<https://youtu.be/l0pj1YzGNAY>



GF - Forget/Remember
<https://youtu.be/bDzDIDMjCgY>



1W - Wall of Sorrows
<https://youtu.be/qjHzuUWNfrA>



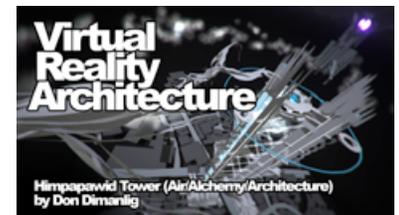
2W - Comic Portal
<https://youtu.be/KqakFfHP7cw>



3W - Accessible Art
<https://youtu.be/HNy9OQ8uhkY>



4W - Glacierport_01
https://youtu.be/_ETRHEBraao



GW - Himpapawid Tower
<https://youtu.be/rM64AzlcXy>



VIDEO:

<https://youtu.be/LkgyUR-xPcw>



NOTES

A. Industrial Filling, cranes, steel frames, rebar

B. More Bldg-Ground relationships variations

C. Effects I couldnt do in physical (Fire)

Mining Facility was Studio 1's cardboard model. Here I recreated the industrial edifice and the quarry. With techniques I learned from the previous drawing, I was able to draw this already smaller drawing much faster. Tiltbrush's heavy paint brush was starting to become my standard "rough terrain" maker. Having drawn many varied shapes, I have learned techniques on how to make volumetric-looking shapes - even with just the use of flat (mesh) brushes to just do 6 sides of a cube, or even just 2 sides and have the mind complete the missing sides - implied. My penchant for messy industrial forms starts to compile a VR "library" in my head - complementary to the library of machines that is already in my mind.

I devised more variations on how the building meets the ground now. Large strokes give a more stable look while small flat strokes look like retaining metal walls. Sharp strokes are rebar poles. I did not have this variety in the cardboard model.

The hole on the physical model was burnt more by actual fire. In VR, I can simulate more fire - without the dangers of the real thing. And it looks great.

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Reality Model

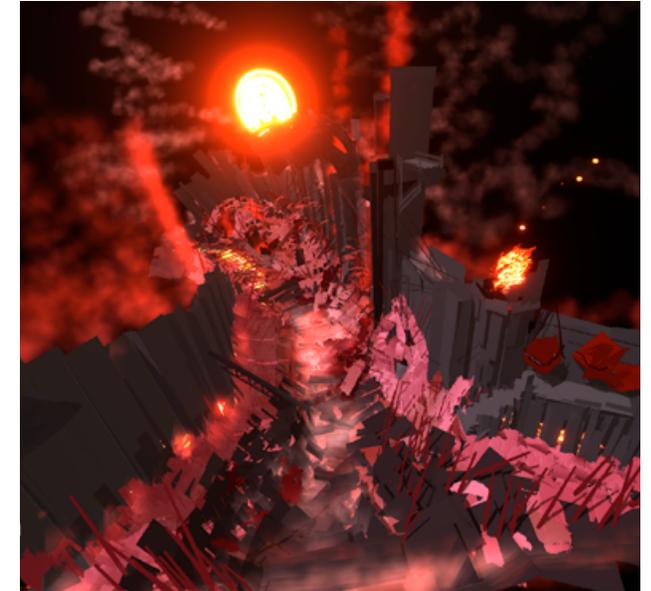


Virtual Reality Architecture

The Wall Of Sorrows
by Don Dimanlig

VIDEO:

<https://youtu.be/qjHzuUWNfrA>



NOTES

A. Safety of VR versus hazardous material

B. Painterly strokes vs Rigid Lines

C. Recapturing an established view from the past, in VR

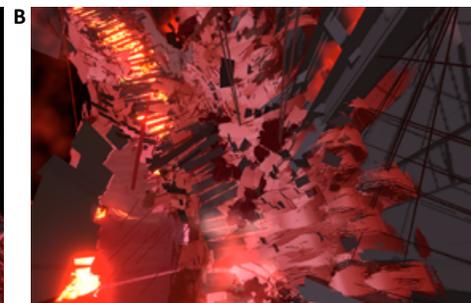
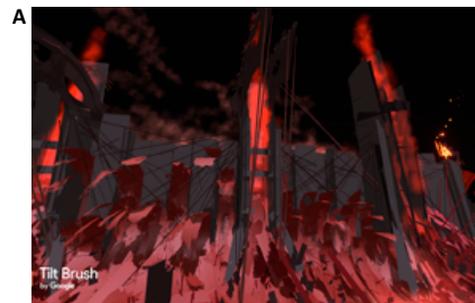
The Wall of Sorrows was made in a risky manner - with metal I sharpened and rusted myself, and wax that i melted, poured and sculptped. VR allows me not only unlimited "material, but also the safety of not getting cut or burned.

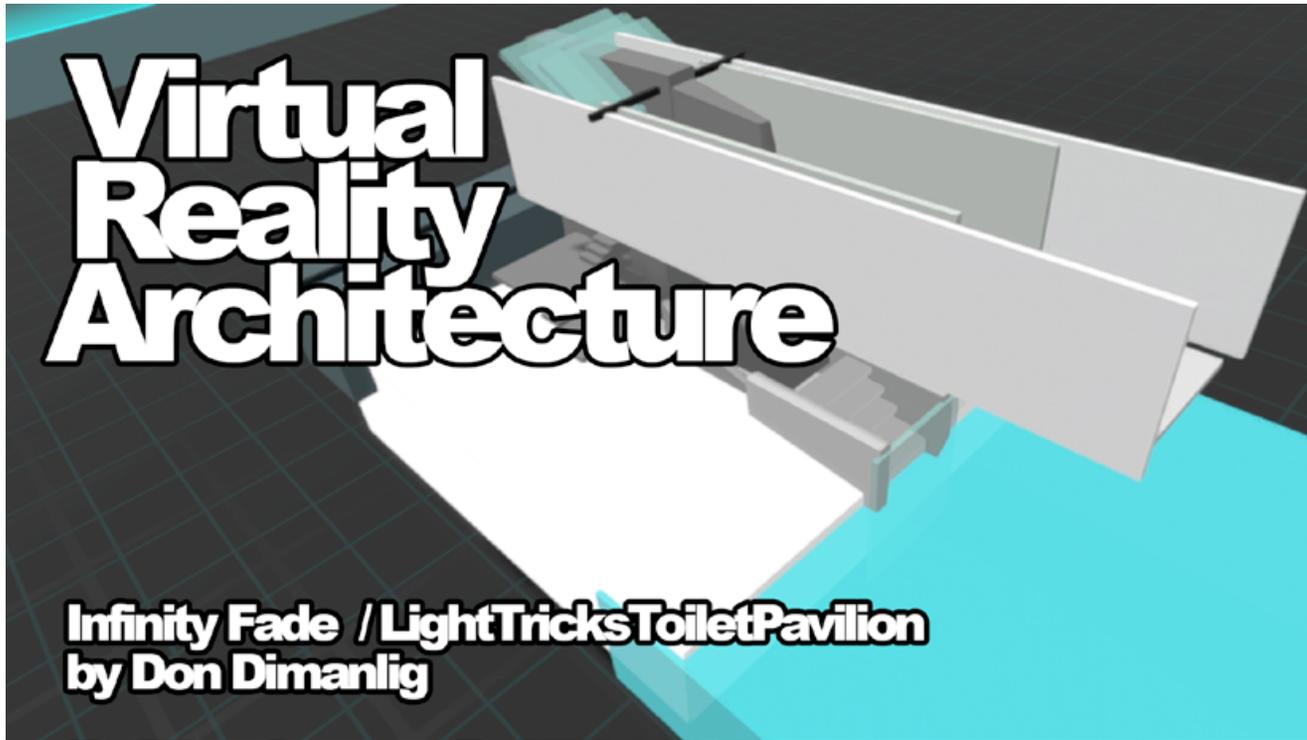
Unlike the relative rigidity of the lines needed for the previous 2 buildings, The Wall's hardened wave of flesh and blood are it's more loose-looking main feature. The straight-tool has been disabled in favor of more painterly strokes. The whole morbid landscape of the valley is like painting on a 3D canvas of aether. You start with the backpainting - then a layer, and another layer, and so on. I tried to ignore the shortcut for Undo in VR so that I act as if I am painting.

In the video, you may catch a significant smile (#####) - it was the moment that I see through VR, the image I have pictured when I built this model years ago. VR was able to recapture the photo I took - the same warm lamp with using the light brush, and position my head where the camera in the past positioned on the physical model.

TRACKER

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Reality Model





VIDEO:

<https://youtu.be/eIKMFgF-80I>



NOTES

A. VR's lack of modelling features

To change it up, I used Modbox to model, instead of Tiltbrush like the usual drawing videos. With my experience with 3D modelling, it is very easy to feel the obvious (and understandable) lack of more 3D commands and functions this early. One just has to be a bit creative with a trusty command. Tiltbrush has the straight/flat brush while Modbox has the basic cube primitive. This cube can be stretched and that will be the basis for majority of the parts from now on.

B. VR's inaccurate / shaky snap

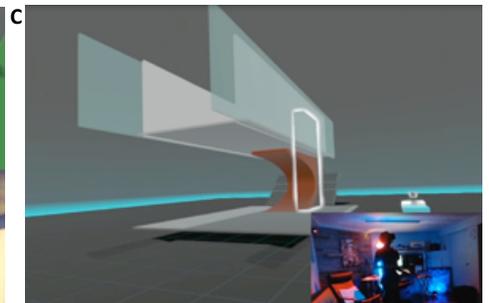
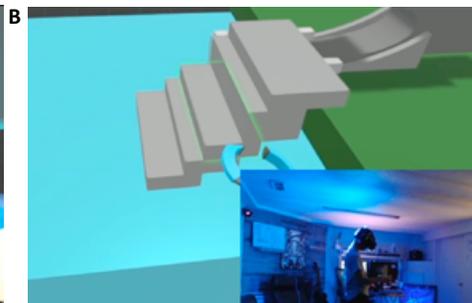
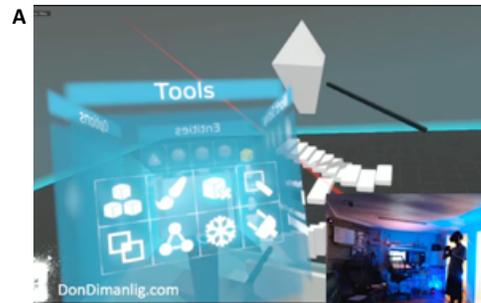
As soon as you are modelling and using figures and not strokes, one would want a reliable snap -however, the locking doesn't feel as good as any conventional architecture program - this leads to messy, inaccurate placements.

C. Advantage of variable Scale

The advantage of this program however is its variable scale - changing the model from a tabletop - to lifesize. Or you can consider it, changing the viewer size - from godview - to human view. This allows you to build things that are bigger than the physical room that you are doing VR in, as well as experience your building in the scale you need to be designing for, whether its massing, or detailing

TRACKER

Tracking Image for Future Use Augmented Reality Model





VIDEO:

<https://youtu.be/KqakFfHP7cw>



NOTES

A. Symmetry

The Symmetry tool was used in earlier models, but not as crucial as it's usage here - a close up of a portion of a bookstore, the comic portal - a sci fi corridor leading to a fantasy vault. The tight hallway and the octagonal room both needed repeating elements. VR is still not a modelling tool - and complete accuracy should be forgotten as the control will shake as a human will shake.

B. Free Revise due to New View

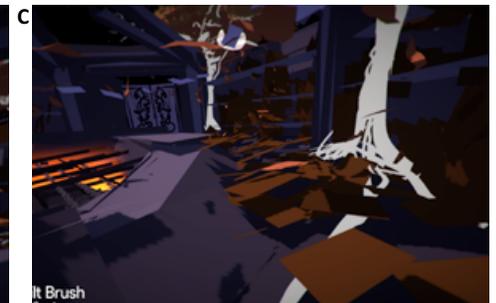
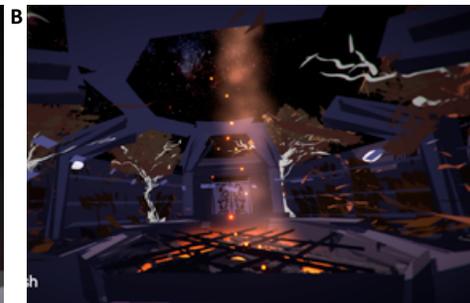
Originally, this area was found underground, however, after sitting in VR, I was able to visualize the parts of architecture I tend to ignore in physical models - the ceilings. The once plain ceiling with a hole is now a ruined dome - open to a starry sky.

C. Detailing up close interior scale

In a physical model, everything was so precise, that its simplicity was good enough presence - however, the inaccuracies of VR made me dislike its plainness, so I added overgrowth of autumn trees. VR's limited tools is sometimes an asset. Where in a physical or digital model, walls and trees would come from different tools / commands, in VR (at least here), I can just use the same brush. Simple yet versatile - much like drawing with a pen

TRACKER

Tracking Image for Future Use Augmented Reality Model

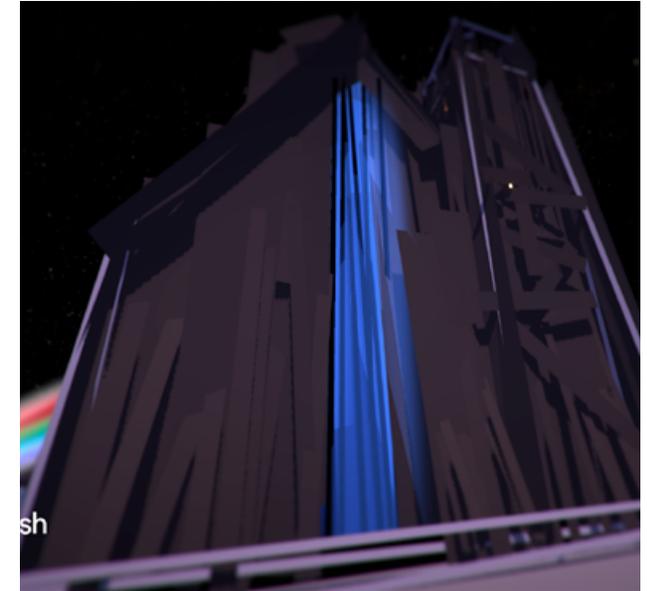


Virtual Reality Architecture

Bluesphemy (modernized)
by Don Dimanlig

VIDEO:

https://youtu.be/Zi8JpIVC__M



NOTES

A. Frustration in redrawing existing architecture - inaccuracy, lack of control

B. Life and activity

C. Reminder: it is VR drawing, not VR modelling. A drawing conveys with any visual means

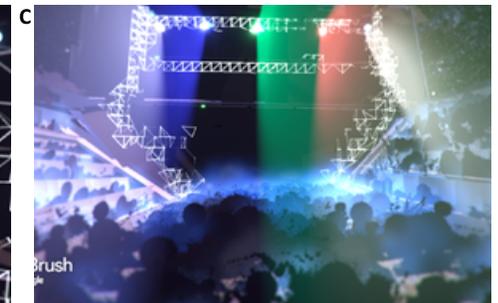
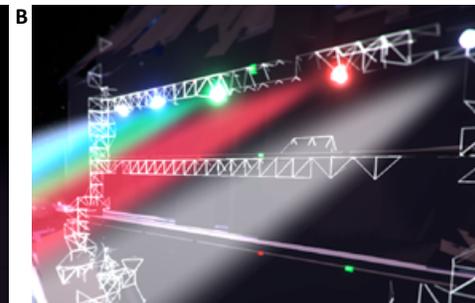
Bluesphemy's idea, a Blues Insititute situated on the required site - beside an ottawa church is to create something so predictable - that no one might try it - making my project unique by doing a cliché - mirroring - with the other out of burnt wood, stripped of all details except its silhouette. Frustrating thing about existing sites, one wants to emulate the building accurately, green patina of the roof, rough texture of stone, the symmetry of a church - trying to mimic proved tiring and almost futile. The added shadow building was easily recreated with the same techniques, now faster and more refreshing because it's conceptual.

The middle performance area was exciting because unlike the original physical model, in VR, I could add more life. Originally, I built a model, and use drawings to set the mood - in VR, I can combine the advantages of both. Lights, lasers, fog, scaffolds, performer and an audience. I can even stand on the lit up stage, or be with the rowdy crowd

Instead of drawing each person in the crowd, I saved time using a splatter brush and a bit of fog. A drawing just needs to visualize - it is not a technical model that needs the accurate count of people.

TRACKER

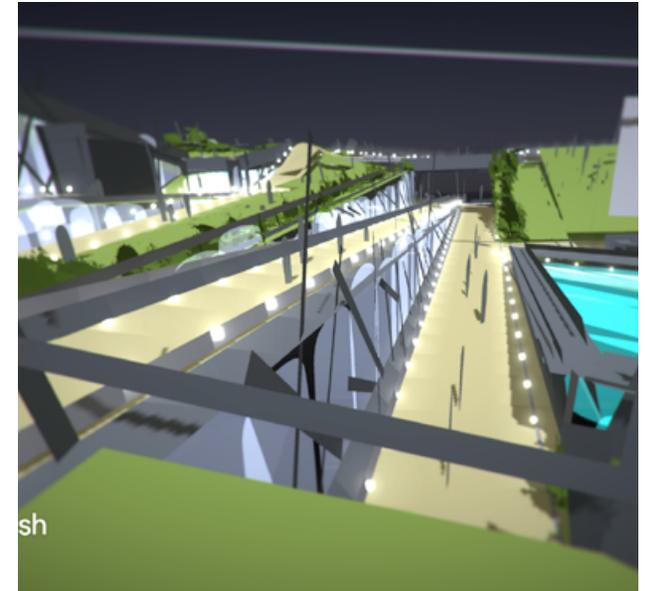
Tracking Image
for Future Use
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Reality Model





VIDEO:

<https://youtu.be/HNy9OQ8uhkY>



NOTES

A. Path planning more natural with hand movement

This redesign for Canada Council for the Arts building acts as a semi underground public park. These paths were designed as shortcuts from busier parts of that area in Ottawa's downtown, from key locations to bus stops. Laying them out, however, in VR is much more fluid than in Revit as one can shift height, angle, length very easily, usually in one dedicated stroke instead of tweaking a 3D model's rectangle into place via control joints / parameters.

B. Arbitrary sticks faster than in Revit, in exchange for muscle tiredness

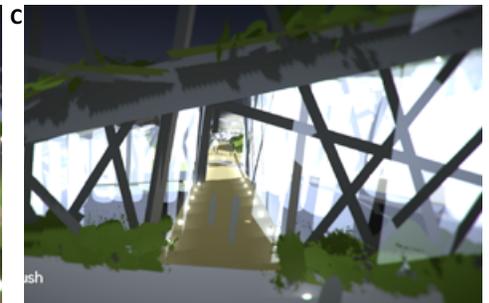
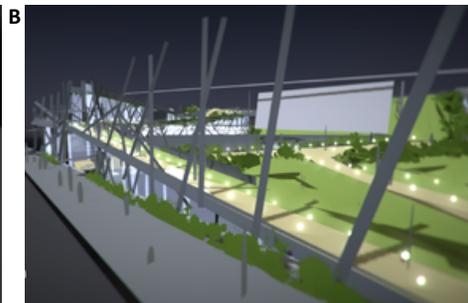
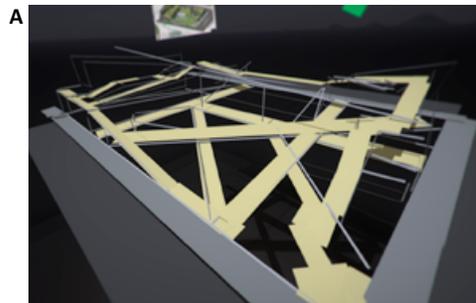
The wall / window mullions however are a bit more random, relying on needed openings / privacy, etc. in VR, this arbitrary drawing of lines has become way easier than the more rigid Revit would require. It's speed however, comes at the price of both inaccuracy and the tiredness of constant hand movement to draw these multidirectional fences.

C. changing from birds eye view to human scale eye by just repositioning / without

Being a public park with many features, it's important that the drawing/model serves the public with well designed spaces - reasonable path widths, acceptable slopes. Literally zooming one's face unto the different locations in the model grants quick access to these views without the need of scaling / placing cameras. VR's adaptive depth of field also makes snapshots better.

TRACKER

Tracking Image for Future Use Augmented Reality Model

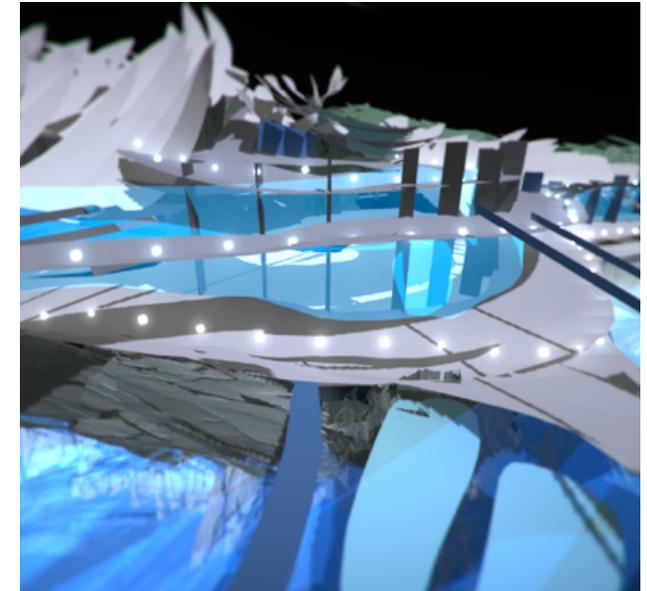


Virtual Reality Architecture

**The Gates (immigrant housing)
by Don Dimanlig**

VIDEO:

<https://youtu.be/l0pj1YzGNAY>



NOTES

A. More complicated designs would need a resizable reference image function

B. Gesture based / freehand shape advantage

C. Layering is still important, not just exterior / skin

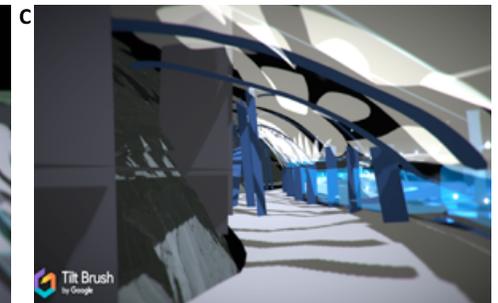
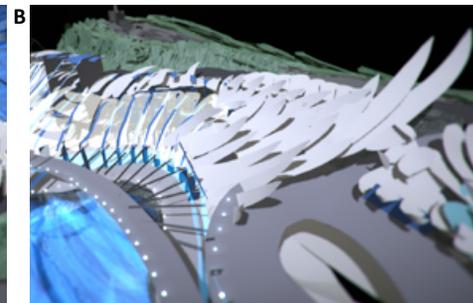
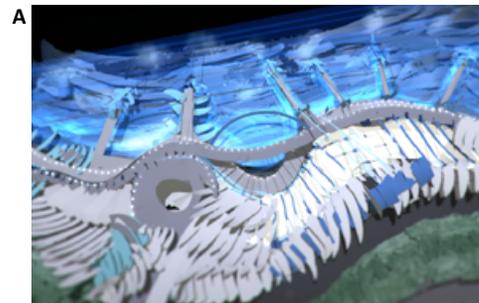
The length, curves, and asymmetry of The Gates made it a bit difficult to recreate in VR accurately without a reference image - scaling function. Would've been easier to trace it. To remedy this, I drew the building the same way I designed it originally - base it off the site's shapes and slopes. I drew the site first then the building hugging it - and reproduced a close enough shape.

This building may be the curviest building I have done in years. The curves in its plan were drawn in paper first before in AutoCAD to not be limited by convenience and actually follow the site. The roof in the original model relied heavily on CurviLoft - a Sketchup Add-On toolbar. What used to require two curved/straight lines then a loft and edit command is now just a quick swipe / stroke of the wrist in VR. The feathered shaped roof looks more natural.

With my previous VR drawings, it was only either exterior or interior. For the Gates, I had to draw as if I am building, as each next layer builds on the shape of the former. Land, floor, structural, roof. The transparency of windows and some roof parts also show the interior - which if left blank - won't achieve a more realized, dense, layered building.

TRACKER

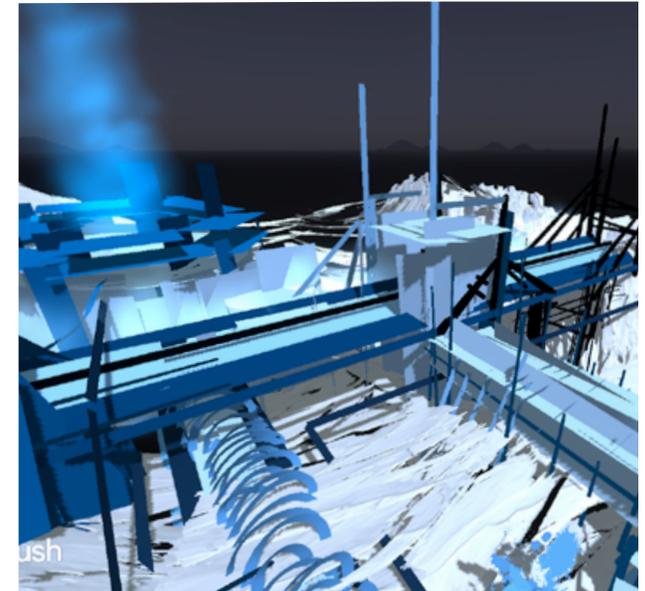
Tracking Image
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Reality Model





VIDEO:

https://youtu.be/_ETRHEBraao



NOTES

- A. First VR Architecture Video of this series**
- B. Flat Brush + Straight Tool Combo**
- C. High Quantity High Speed**

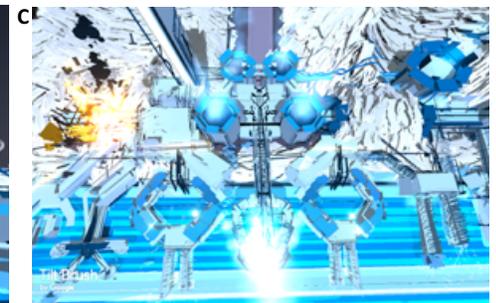
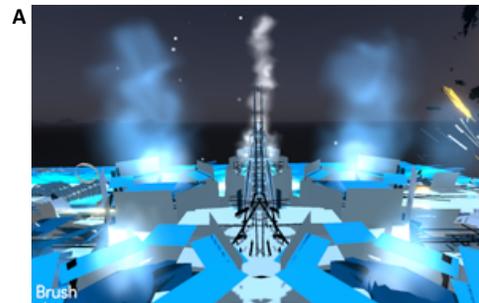
Glacierport 01 was the first VR drawing that focused on architecture. (First in this series). I chose it as my first because it's a personal favorite. Glacierport is a 2km long Ice-manufacturing Arctic facility. Since I know the scale of the drawing, I started plotting the perimeter of the building, roughly. I also established a comfortable height as Tiltbrush doesn't allow shifting yet.

This was the first time I used the Straight-Tool extensively, turning the strokes into planes. It is the closest thing to a Wall / Floor tool as I can get in this drawing program. After the Tundra and Icy waters were drawn, I modelled the facility, sector by sector. Drawing the train-track that goes throughout the facility gives me an estimate for the size of each part. I already found it more interesting re-building Glacierport on a rougher terrain compared to the original flat SketchUp terrain I made for it before. The freedom of movement makes having intended and accidental fluctuations much easier - leading to surprising developments. (more on that later).

In 2 hours, I was surprised that VR was able to capture the complex essence of what GP01 was, in such a short time.

TRACKER

Tracking Image for Future Use Augmented Reality Model

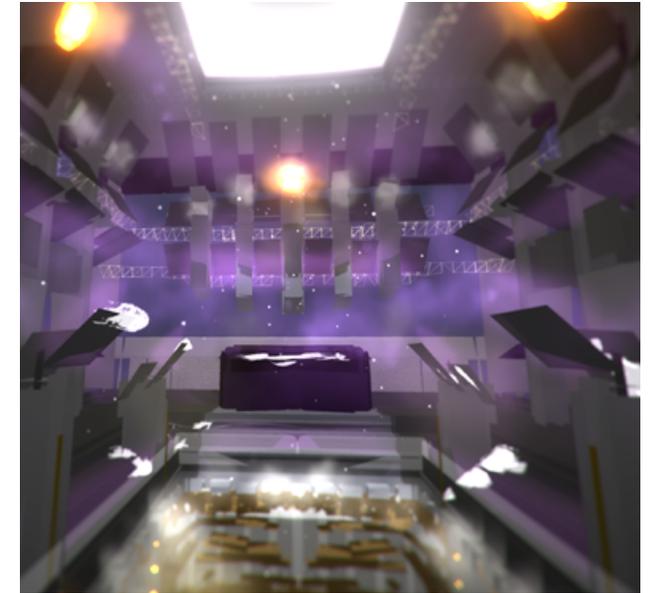


Virtual Reality Architecture

Forget To Remember / Remember To Forget (OPLibrary)
by Don Dimanlig

VIDEO:

<https://youtu.be/bDzDIDMjCgY>



NOTES

A. Streamlined for Interior Only
/ Drawing from inside

B. Temperature and Coloring after drawing

C. Height / Vertigo effect

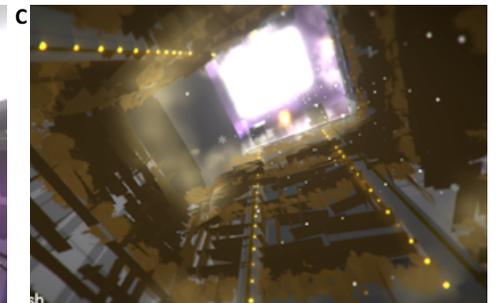
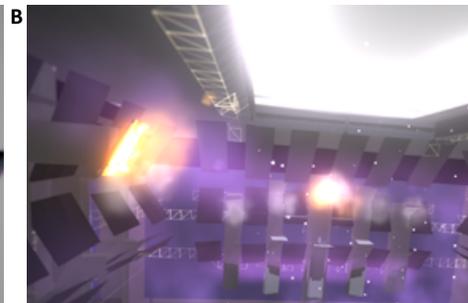
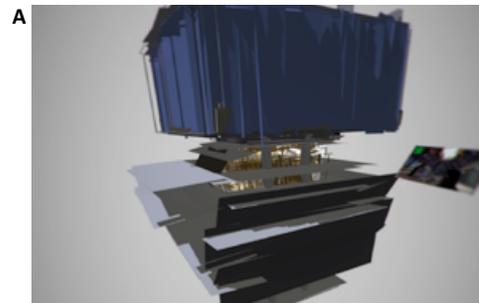
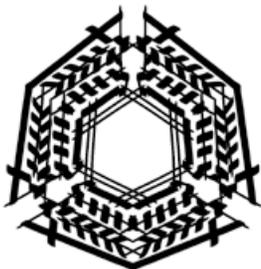
The concept for this library is isolation from the outside world - no one sees the out from in, vice versa. I have originally built this model with the interior core in mind - similarly in this VR drawing, I stood in the middle and drew from within. Disregarding what the outside shape may look like - it didnt matter in the original, so its just as irrelevant here.

This library has an open roof, for light, air, snow, rain, and muffled city noise to come in. This makes for a tricky temperature and remedial HVAC situation. The model is drawn just in greys, but the effects of cold and warmth are easily drawn over in VR. Strokes of white for snow piles, the animated snowflake falling, the purple hues by carefully laying translucent smoke, the exaggerated brightness of the roof opening to contrast the dark interior, and mixing warm orange to a moving blur to mimic heat distortion.

Counter-intuitively, the atrium actually felt more vertigo-inducing in the videogame engine the original model was in, compared to in VR. As immersive as VR is, when the drawing doesnt scale - and there is no in-model gravity, it loses the 'fear of heights' effect. Because the ratio of head movement to view movement is off when drawing off-scale.

TRACKER

Tracking Image
for Future Use
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Reality Model



Virtual Reality Architecture

Himpapawid Tower (Air/Alchemy/Architecture)
by Don Dimanlig

VIDEO:

<https://youtu.be/rM64AzlcJxY>



NOTES

A. Physical Height Limits

/ Need Floor Height changer

B. Painting smaller buildings using patches

C. Circles - makeshift compass using body movement + controller straps.

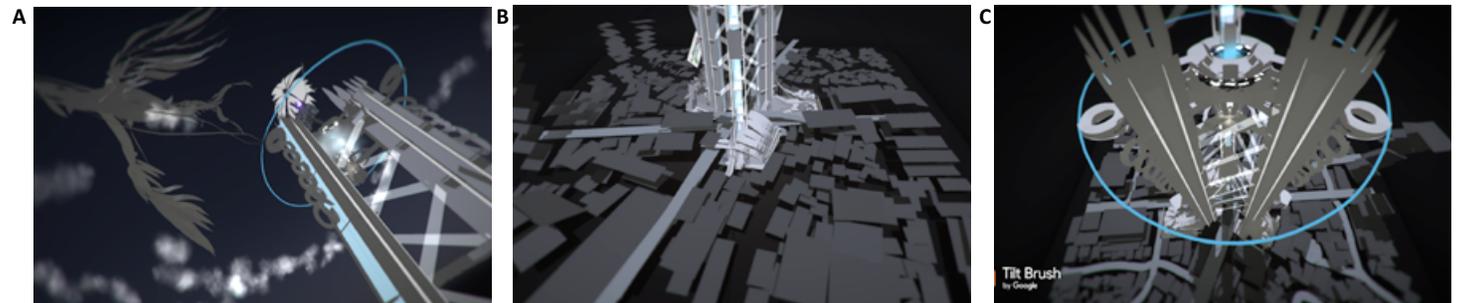
Drawing a scaled down 380m tall tower in my 6'4" tall basement is a poor combination. Tiltbrush may have a wide horizontal span thanks to the teleport function, but the vertical range is still limited as you cannot change the height plane / scale the models. The only way to make buildings seem tall is to draw references - like the site.

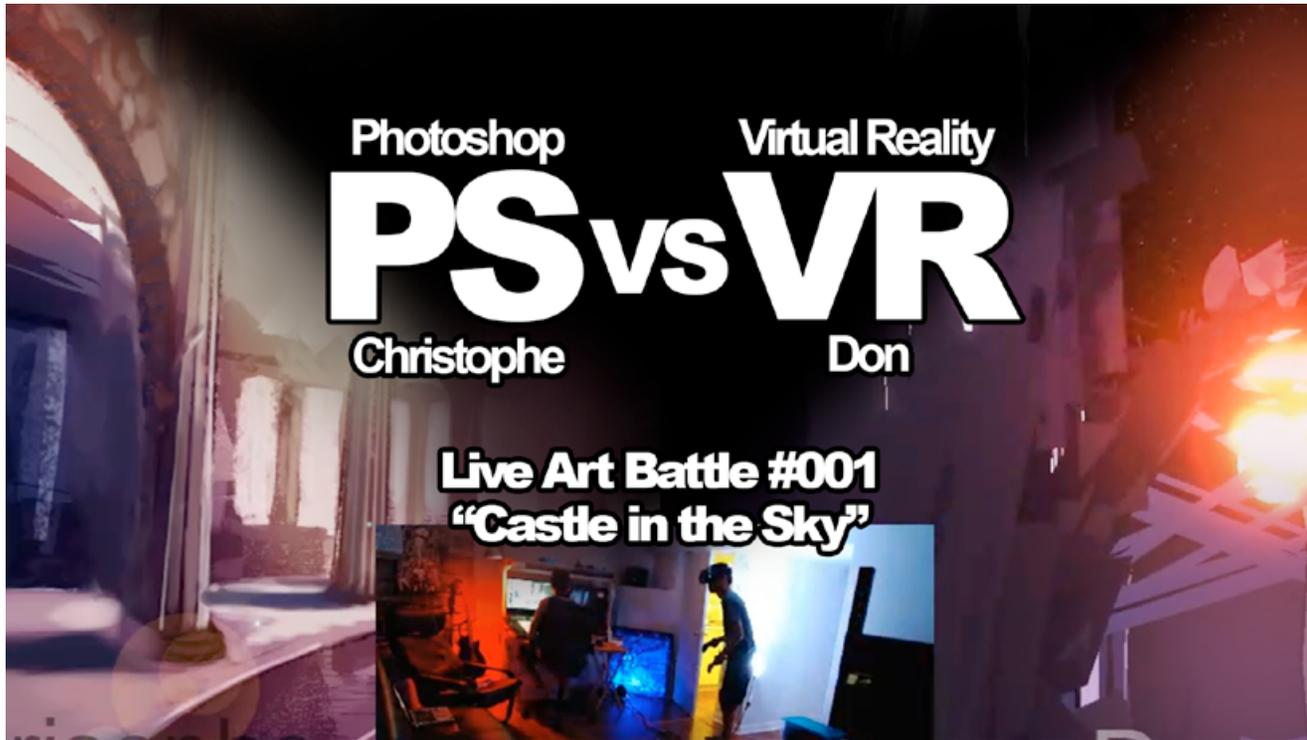
The dense Philippine downtown site is a mix of towers, highrises, malls, and small homes. This is VR drawing, not modelling - so I tried drawing it like painting patches - the variation in sizes and heights will give it the complexity / density because of the overlaps and the shadows. Mixing a controlled color palette here would've probably given an even better effect.

Besides the challenge of the Y-symmetry of the towers, this building also has the biggest Circle I ever had to draw in VR. With no built in ellipse function, I devised a way to draw a circle, but making the center of my torso as the pivot, extending the controller half by it's straps and moving my arm as a compass. With a few practice runs, I got a decent, clean circle. It's interesting to see traditional (or even ancient) techniques come back in use in something so new and advanced.

TRACKER

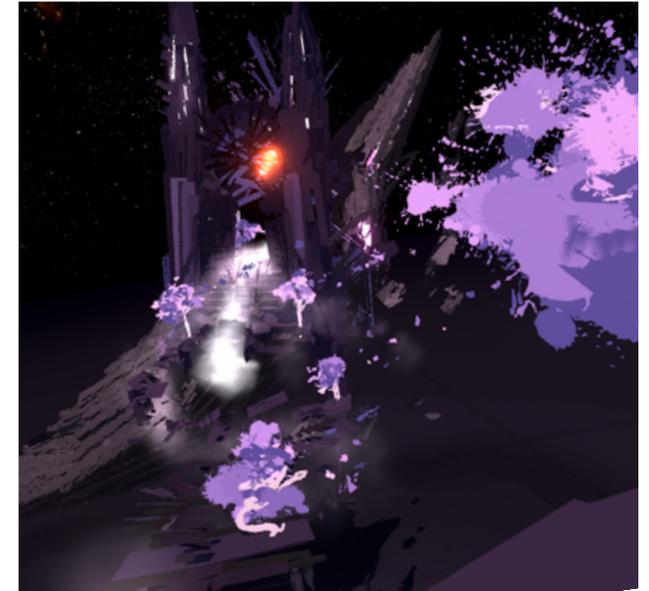
Tracking Image
for Future Use
Augmented
Reality Model





VIDEO:

https://youtu.be/HzZp_HbNOMU



NOTES

+ 2D vs 3D drawing analysis

+ How to “sketch” in space

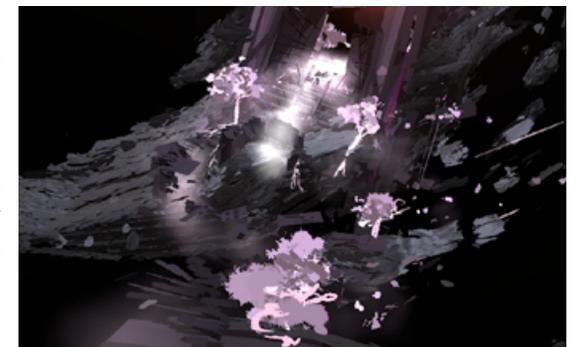
+ How to imagine without a surface

To compare VR drawing to Digital Drawing a bit closer, I decided to record a drawing session with a friend. He draws in Photoshop while I draw in VR. We decided on a theme: Castle in the Sky. We wanted something similar enough that we can compare elements, but lose enough to do our own styles.

This is the first building I draw in VR that has no existing basis. I immediately realized the difficulty of coming up with an idea without going out of VR and on to paper. Sketching in VR feels too loose - I try to press into an imaginary flat surface (like a paper / tablet screen), as if my muscles in my hand require that contact in order to start thinking. I pressed on and sketched what I can in floating space even tho the sketch ‘disintegrates’ as soon as you move your head and change the viewing angle.

My friend drew an interior shot, while I drew from the outside. This can either be because of merely our starting idea - or could be caused by how we are framing the “shot”. Photoshop starts in a rectangle, while VR has a panoramic view. It almost sounds counterintuitive.

Another possible cause of this contrast is because of the lack of scale-controls in tiltbrush tend to prefer drawing the overall/manageable miniaature versions of buildings. Instead of drawing it surrounding me, I just draw them small and then enter them and view it closeup - which has the same effect.



4.7 - Data Case Study

VR Buildings (10 videos)

see Youtube Links



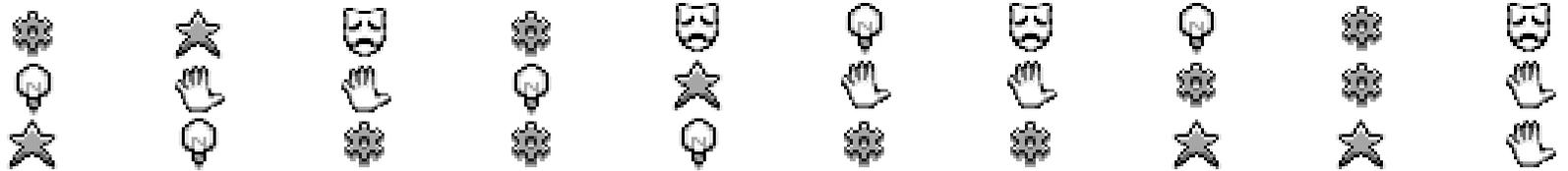
Notes/Tech Discoveries (3 each)

see VR Video Panels for further Notes

industrial memory	safety from hazard materials	VR still lacking feature/functions	symmetry - linear / axial	existing site, poor material emulate	path planning, natural feel	need reference plan / scale	Intuitive first VR bldg drawing	interior only priority sketch	physical height limit (pre update)
building and terrain contrast	painterly strokes vs rigid structures	inaccurate snap / human shake	free revision due to new views	life and activity, movement	arbitrary stick, speed vs tired	gesture based shape advantage	flat brush + straight tool	temperature and atmosphere color	patches = sprawl splatter = people
effects I couldn't do physically	recreate old established views	perspective by changing scale	up close detailing (preScale update)	"Drawing, not modelling"	perspective by changing position	layering for density / realism	Quality and Quantity in speed	height vertigo effect attempts	use body + strap as a compass

Categorize each point

what aspect / nature of VR / art is this point about?



Group to learned Categories

Summarize what these points have in common and what did I learn from them

Thought Process (6)

channel the archives of architectural / industrial references in your head so one can draw without referencing outside VR, use intuition to layout new plans, think of machines and fill it up, sketch the thought inside and densify as the ideas build - revise as you go.

Method / Techniques (9)

zoom in and out while drawing (before the scaling update), take advantage of the building+terrain contact points, flat and straight brush is your bestfriend, symmetry for fast composition. Get close for detailing and apply color temperature afterwards.

Tricks & Effects (5)

take advantage of non-physical effects such as fire, ice, lightning and other dangerous things. Use speed to advantage - add lights and movement. Make tall seem tall, make bright really bright. Use effects to emphasize and distract.

Body Motion (6)

forget inaccuracies and shakiness and embrace the flaw and keep drawing. Apply painterly strokes with hand gestures and use different wrist, forearm, arm, wingspan radii to tackle different shapes and distances. Conserve energy, draw wisely.

VR (4) Shortcomings

drawing existing site and material accurately is frustrating and time consuming, Reference image command isnt scalable for tracing, important features came in too late (3D import, resize and rotate, export, teleport)

Final VR Drawing!

Use the 5 points as guideline in drawing the final piece

Repeat

and study further!

FINAL VR DRAWING

5 - Final Drawing

5 - Final Drawing

5.1 - Novus Locus Magnum Opus

The Final drawing consummates all the VR techniques + categories I have gathered so far, but even then, the drawing doesn't live up to its name - as VR is only ever growing -getting more functions by the day. A Non-finito VR drawing, ever expanding, ever detailing. A Plato's Cave in which you are the prisoner, the shadow, the freeman, and the cave itself.



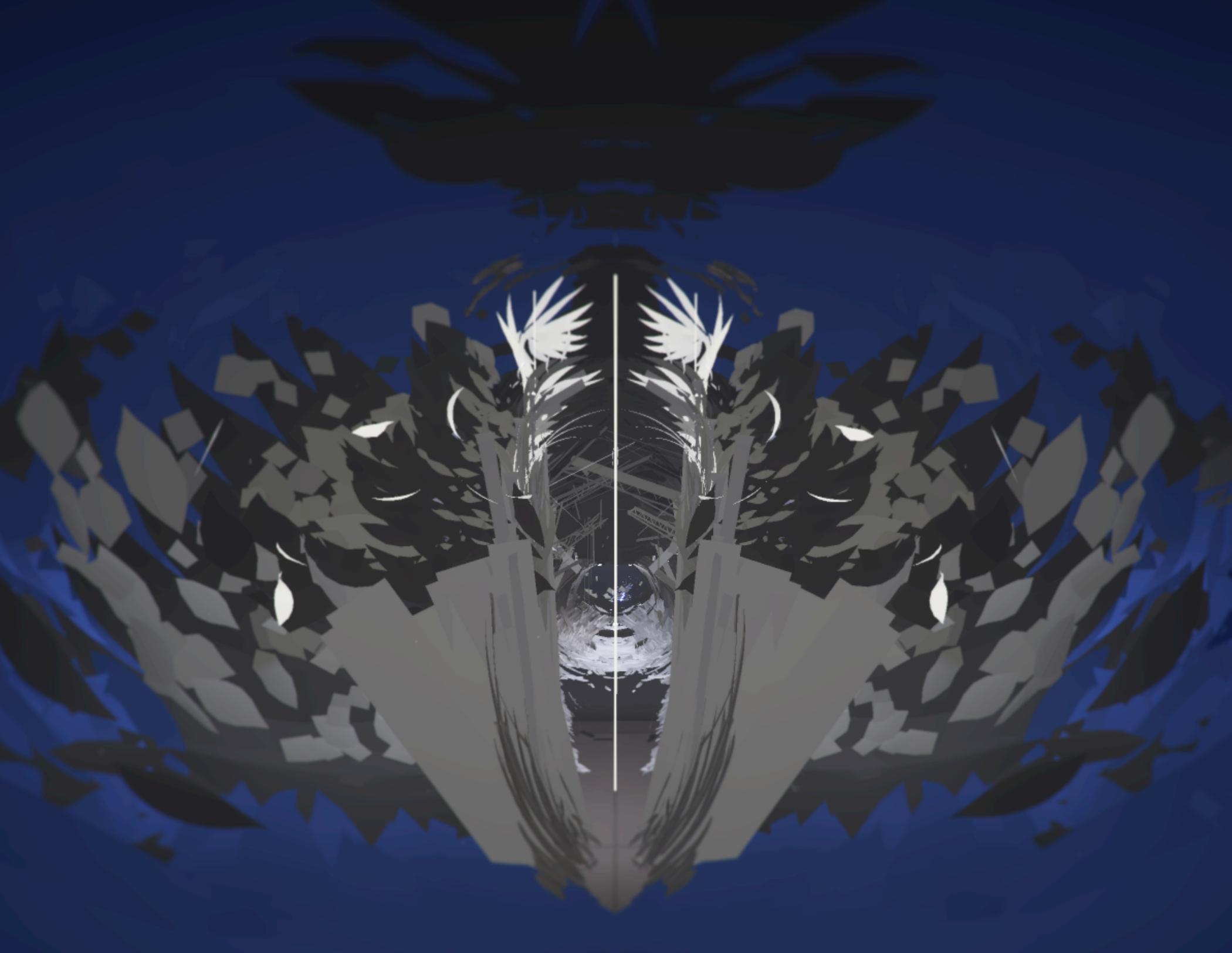
VIDEO:

<https://youtu.be/176cZEKkiYU>



Virtual Hands of The Architect > 5 Final Drawing





6 - Conclusion

Conclusion

As first presented in the introduction, this was an unconventional thesis. Its method is self-referential in developing a new method of three-dimensional drawing in Virtual Reality. Its aim, to find out how VR can affect architectural design through drawing, sought to develop a viable, effective, new form of art. In this manner the thesis is process driven, developing much of the work as a series of observational exercises and case studies in an effort to understand the implications of drawing in VR and to form some form of lexicon by which it might be examined in the future. This is therefore a field of study very much in its nascent stages of academic scholarship.

VR drawing is about immersing oneself in the drawing. The objective is comparable to some forms of art in the past, such as when giant canvases devour the viewer or when trompe-l'oeil encapsulates a space. Its influence, in the present, is potentially people's access to panoramic views via their mobile device. In the future, it suggests where immersion is not only in the drawing's viewing but also the drawing's process. Where individuals are inside the drawing as its being made.

The process of trial and error has been crucial to this study – almost a “draw now, ask questions later” mentality arose as the project progressed towards its unforeseen conclusions. Unlike functions presented by built in VR tools, the more notable techniques came up when finding a solution to VR's limitations, (being a relatively new drawing medium).

VR Architectural Drawing starts with emulating existing / similar commands from typical architecture programs (such as AutoCAD / SketchUp), but to truly unlock its potential, VR has to be treated as its own – find techniques that can only be done once in a simulated environment of analog control of digital drawing.

It is surprising how adding a dimension to drawing, requires adding another dimension to our thinking. If drawing architecture in a 2D plane requires a 3D thinking mind, drawing architecture in a 3D plane requires a 4D thinking mind – what that 4th dimension entails, is what further research will hope to discover.

VR is a wide subject but I hope focusing on the architectural drawing capability of the medium narrows it down enough to inspire further interest from other people. It has potential and should be studied further with more drawings – one never knows what will come out when the architecture and the architect's hands are one step closer.

Don Dimanlig

7 - Bibliography

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VIRTUAL HANDS OF THE ARCHITECT

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