

ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE



TEZE K DISERTAČNÍ PRÁCI

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Fakulta Architektury
Katedra Modelového Projektování

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**ARCHITEKTONICKÉ A UMĚLECKÉ PROSTORY PROSTŘEDNICTVÍM VIRTUÁLNÍ
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Teze byly rozeslány dne:

Obhajoba disertace se koná dne v hod. před komisí pro obhajobu disertační práce ve studijním oboru ATT v zasedací místnosti č. Fakulty Architektury ČVUT v Praze.

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Abstrakt/Abstract:

My research is looking for new interpretations of architecture in our digital era. I define VR Architecture, architecture for the metaverse, virtual 3D environments online, 3D internet. There is a new direction in architecture developing in the metaverse. I will use literature as well as my case studies to support my ideas. I will find evidence that should show how important the virtual space became in our age. During Covid pandemic era we learnt how important is online education and online work from home. 2D internet is essential now. My dissertation is about 3D internet, the metaverse and how to design it. Programmers, IT specialist, VR specialists together with architects, designers, and artists should participate in the design of these architectural and artistic spaces for virtual reality online environments, the metaverse.

Klíčová slova/Keywords:

VR Architecture. Architecture. Digital Architecture. Metaverse. 3D internet. Virtual worlds. Virtual environments. Virtual space. Virtual reality. Digital art. Cyber art. Generative Arts. Neos VR.

Úvod/Introduction:

Architecture should quickly reflect the change that is happening in our digital era. We cannot imagine living our lives without using smartphones, tablets, computers. We are creating our virtual lives on social media like Facebook and Instagram etc. We use the internet many times a day for communications with others. We work online with colleagues, we study online. We use online banking, book our holidays online, we shop online, we navigate with maps online every day. Some activities from physical world moved online to virtual space on 2D screens of our computers or phones. There is a 3D internet with 3D virtual reality environments, the metaverse. Today most of the metaverse projects are designed by game designers and programmers, VR specialists. The topic of this dissertation is that architects and artist should be part of the team designing the metaverse. I am trying to answer how to design the metaverse as architectural and artistic spaces in virtual reality.

Beatriz Colomina in 2017 during her lecture in Prague asked the question: If we no longer pay attention to the existing cities, what will happen?

My question is: What happens in virtual reality architecture online if people will be inhabiting that virtual space?

We are architects, designers, artists, we should design architectural and artistic 3D space in virtual reality, the metaverse.hYPOTÉZA

Hypotéza/Hypothesis:

Digital Art is Growing into Architecture for Virtual Reality. Vincent Guallart writes about the meaning of the word digital: "New Technologies make it possible to transform data flow to the point of creating authentic landscapes. Spaces with or without gravity. The paradigms and the physical laws of the real world are not necessarily applicable to the virtual world. But this virtual world could be a clone of a real-world or generate infinite possible spaces, like a world with infinite times and therefore infinite possible, parallel histories. Quasi-real spaces. An acoustic space: a music room. A fractal trajectory. A mountain of infinite dimensions. Cloudy dawn: a city. Settings for virtual meetings and real use. Spaces and computer programs accessible from an intermediate space that can lead to a virtual world full of real content." Architectural and Artistic Spaces through Virtual Reality will become a new direction in architecture in the future.

Výzkumné otázky/Research Questions:

Actions from the physical world are moving to the virtual world online. We communicate online, we work with online information, we study with online information, we search for information, we socialize online, we share information online, we relax by reading texts and watching videos, we play games, we shop online. We use websites to search for information in 2D screens of smartphone, tablets and computers.

What if in future the online actions will happen in online 3D virtual shared worlds in virtual reality/metaverse, designed by architect, artist, and IT professionals?

What kind of activities will move into virtual reality online worlds?

How can we define functions from these activities in virtual reality online worlds?

What kind of elements will these functions need to create 3D space in VR?

How can we as architects and artist design Architectural and Artistic Spaces in Virtual Reality in social VR platforms, in my case in Neos VR?

Will Architectural Space for Virtual Reality be developed as a new direction in Architecture?

How can we design Architecture for Virtual Reality?

How Architecture for Virtual Reality will look like?

Metodologie/Methodology:

I work mainly by using the method research by design, I am searching for supporting materials in literature, I use logic induction and deduction. I am comparing the design guidelines from Vitruvius Ten Books on Architecture and the possibility of designing architectural and virtual worlds in NEOS VR. I try to define new elements and new functions for Architectural and Artistic Spaces for VR. I look for supporting materials in the history of art and architecture that shows evidence from the theory of architecture in history from Vitruvius book De Architectura. I use a recent book about elements of architecture from OMA/AMO, Rem Koolhaas Elements, the result of this research was shown on Venice Biennale in 2014. For the research purpose, I create 3D models, renders, digital collages, models in virtual reality and animation. I try to verify my principles, the hypothesis, and the research questions. My findings are compared with recent research in the field of contemporary digital art, contemporary digital architecture. By my methods, I would like to find new meanings of the word architecture and define Architectural and Artistic Space Through Virtual Reality, VR Architecture in the metaverse.

1. SOUČASNÝ STAV PROBLEMATIKY/CURRENT STATE OF THE ART

My Definition of VR Architecture in the Metaverse:

VR Architecture exists only in computer simulations in the metaverse. VR architecture is not for construction in the physical space. Avatars inhabit VR Architecture in social VR platforms (like Neos VR or the new META) or other types of metaverse for education, work, shopping, or gaming. VR Architecture applications are in 3D environments, virtual worlds in social VR platforms in the metaverse and the 3D internet of the future. VR Architecture is a 3D environment inhabited by avatars online designed by architects, artists, and programmers in collaboration. This dissertation is a sample of how art and architecture can inspire VR architecture. How to define VR architecture and how to design it, what are the steps that architects could take if they create it? These are the questions that I am searching for answers to. Application of VR Architecture is in 3D internet or social VR worlds in the metaverse.

Architecture should quickly reflect the change that is happening in our digital era. We cannot imagine living our lives without using smartphones, tablets, computers. We are creating our virtual lives on social media like Facebook and

Instagram etc. We use the internet many times a day for communications with others. We work online with colleagues. We use online banking, book our holidays online, we shop online, we navigate with maps online every day.

My question is: What happens in virtual reality architecture online in the metaverse, if people will be inhabiting more and more the virtual space? We are architects, designers, artists. We should design architectural and artistic 3D space in virtual reality.

Virtual Reality and Computers.

Devices for VR represents an interface, a way of interaction, the dialogue of human being and computer. VR is also a way how to present complicated information, manipulations, and interactions with the human and computer. VR is the most immersive possible interaction with the computer so far.

Short History Computers and VR technology and Basic Terminology

The computer as a term exists from 1613. It was describing a person who did calculations or computations. Until the end of the 19th century was the computer used the same way. Computers had the primary use to calculate during the industrial revolution and the rise of machines. Alan Turing designed the first modern computer in 1936. He built the foundations for the theories about computers and computing.

There exists a simple rule for using machines. It works like this: The more complicated the computer, the more complex interface the computer has communication with the human. Machines interacted with people only by buttons and holes in the paper. There was a possibility to communicate through texts. The communication between human and computer worked like this. A person could write on the keyboard the program according to that the computer knew what to do. As a result, there was an answer from the computer by the text. It was much easier to communicate with the computer by developing the graphic interface GUI in the 70. It means you could work with the computer by the mouse and clicking to the icon, image. As a result of that, the computer could give you the answer an image, text, or a sound.

Each time we need to put the information to the computer, we get the response back from the computer. Today the virtual reality devices are so advanced that we have a chance to be immersed with the 3D environment and navigate through this space being surrounded by information and manipulate with them. We can experience being in a 3D world in VR that has never existed before. We as humans can easily naturally observe and understand spatial information because it is how we live in daily life. Now we can use this with the

work with the computer. The Sci-fi story *Neuromancer* used the world cyberspace 1982 by William Gibson.

Technology and history of virtual reality. Ideas about VR in Sci-Fi literature.

Cyber art in VR, Social VR platforms in the 21st century.

There is a history of virtual reality inventions, books, sci-fi books, etc: Teatro Farnese 1618, 1787 The Panorama, 1838 The Stereoscope, 1898 The invention of Lenticular Printing, 1935 Pygmalion's Spectacles, 1950 The Veldt, 1957 Sensorama, 1960 Telesphere Mask, 1961 Headsight, 1963 Teleyeglasses, 1964 Simulacron -3, 1965 The Ultimate Display, 1967 TV Helmet (Portable Living Room), 1968 The Sword of Damocles, 1973 World on Wire, 1975 Videoplace, 1976 Data Gloves, 1980 EyeTap, 1982 Tron, 1982 The Judas Mandala, 1984 *Neuromancer*, 1985 VPL Research, 1987 Jaron Lanier establishes the Term Virtual Reality, 1987 The term virtual reality is written in the Oxford English Dictionary, 1988 Legible City, 1990 View, Virtual Interface Environment Workstation, 1990 Augmented Reality, 1991 Virtuality, 1992 Cave, 1992 Snow Crash, in his novel, Neal Stephenson presents the Metaverse, how he envisions the further development of the Internet into virtual space. Avatars/users populate the Metaverse. Humans flee from a reality in which large corporations have sized power and governments exist only symbolically. 1993 America's Finest, 1992 Home of Brain, 1993 Inter Dis- Communication Machine, 1993 Simulation, 1995 Virtual Boy, 1995 Las Meninas, 1995 Be Now Here, 1995 Strange Days, 1995 Forte VFX1, 1995 Global Interior Project, 1996 Bodies Incorporated, 1997 Able Skin, 1998 World Skin, 1999 ARToolkit, 1999 Matrix, 1999 Minesweeper, 1999 eXistenZ, 2000 ARQuake, 2002 Minority Report, 2002 Hidden World of Noise and Voices, 2002 Instar, 2003 Gulliver's Box, 2003 Second Life, 2003 Can You See Me Now, 2004 Apparition, 2004 Das Rheingold, 2005 Digital Graffiti, 2005 Gulliver's World, 2006 Mahler's Resurrection Symphony Visioned Futurelab of Ars Electronica and the artist Johannes Deutch from Vienna created the illusion of the three-dimensional space, 2006 Le Sacre du Printemps, 2006 Rainbows Ends, 2008 Smartphones and Augmented Reality, 2009 Deep Space, 2011 Black Mirror, 2012-2013 Oculus Rift and Google Glass, 2003 Can You See Me Now, 2004 Apparition, 2004 Das Rheingold, 2005 Digital Graffiti, 2005 Gulliver's World, 2006 Mahler's Resurrection Symphony Visioned, 2006 Le Sacre du Printemps, 2006 Rainbows Ends, 2008 Smartphones and Augmented Reality, 2009 Deep Space, 2011 Black Mirror, 2012-2013 Oculus Rift and Google Glass, 2014 Google Cardboard, 2015 Quasar, 2015 Hololens, 2015 In the Eyes of the Animals, 2016

Pokemon GO, 2016 VR, AR is going mainstream, 2016 Futuristic Visions for Augmented Reality and Virtual Reality, 2018 Ready Player One, 2021 I call it "META Age" Facebook is developing a new metaverse with AR and VR, META. Other new metaverse projects emerged and they are fully functional in the metaverse: Metaverse CEEK, Decentraland, Illuvium Metaverse, Bloktopia Metaverse, Enjin, Audio Metaverse, Axie Infinity Metaverse, blockchain games, 2021 NFT's boom.

How is this search in virtual reality projects related to architectural space? In some cases, I found projects that are linked, because they are interpreting architectural space. For example, in 1787 the painter Robert Barker created The Panorama from the painted city, or when in 1964 in Simulacron -3 Daniel F. Galouye wrote about his virtual metropolis in a book. This computer-simulated city was filmed in 1973 as World on Wire. The similar interpretation of the virtual world is in TRON 1982 sci-fi movie. These film visions are very valuable for the design development of the virtual worlds now when we have the available technology to create VR environments. We can inspire from those movies as architects, designers of VR worlds.

Introduction to the NEOS VR social VR metaverse.

Possibility how architects can use this platform for importing 3D models into virtual reality. Neos VR is a social VR platform, metaverse that is available on Steam VR for free. Data are saved on the cloud of Neos. To use Neos it is essential to create an account in Neos with login information and password. You have 1GB space available for free to import 3D models into Neos VR. Right now, Neos VR is mostly used as a platform where you can meet other avatars online, create own worlds and import 3D models and then you can move in the metaverse and share and show the space to other avatars in VR.

What will happen in the virtual 3D worlds it depends on what kind of activities will transform from the physical world into the virtual world online in VR. For example, it will be communication, education, shopping, business, relaxation, games. The only gaming industry is now really developed field in VR. It is part of my research and my case studies to define what kind of activities, functions will occur in virtual worlds and how we can adjust to the new type of movements like flying and teleporting in 3D space. How can I define these new activities, new functions, and different architecture in virtual reality? I am searching for answers on how the new type of movements in VR like flying and teleporting in VR will transform architecture in VR. Recently existing social VR platforms are very close to the gaming industry. IT specialist, programmers and

gaming artist are designing VR worlds, VR environment. But this is where I see new opportunities to connect the architectural field and gaming VR industry with IT together.

Avatars – representation of humans in VR.
Artificial Intelligence in VR. AI Avatars in VR.

Avatar's need in VR in comparison to human needs in physical space.

There are three categories of avatars in Neos VR. Automatic avatars that everyone receives when the person is in Neos online. It is just a headset without body and hands. The second, simple avatars with sphere head and hands and the last group are 3D figures that have human-like bodies with legs, body, arms, and head. The third is the most complicated group of avatars because we can import a 3D body that we create in another 3D program. Before we do that, we must import the 3D model to MIXAMO program. It is a program where we can assign joints on the body in the MIXAMO program to the actual points on the 3D model. We can program bodies of avatars like AI in LOGIX. The LOGIX programming is very complex and suitable for IT and advanced users, we can program complex movements of avatar body like flying. We can program the whole environment in VR. In Neos VR, we open the Avatar creator that has another 3D model of head and hands. We have to our 3D figure adjust to the 3D head sphere and 3D hands. Then we click to lightening button then we are reborn in our new avatar body. For some reason, the avatars that have a human body and animal head are popular among the users of Neos VR. Having a body in virtual reality means a lot for the perception of the VR space. Now we are used to the keyboard and mouse or touching the screen. In the body of the avatar, we can inhabit the whole virtual space. Avatars create new activities in virtual space online. Our body in physical space defines what we can do in that space and what kind of activities we do. There is a similar situation in the virtual reality space. Activities define the functions and use of architecture in physical space. In my opinion, it is like the situation with the virtual space. We can derive activities that avatars can do in virtual reality. Activities in VR space are kind of morphing into new type of actions and activities, that will define new type of functions for architecture in VR.

Not only housing but also work, education and leisure activities can profit of VR online worlds like NEOS VR. The education system and all types of schools and universities would benefit from the VR. There is a possibility of how to use VR for education purposes. In this project, we see how to use a skeleton 3D model in biology. This project in VR shows a better image of the whole human

body in VR. My question is what kind of spaces I can imagine building in 3D to design a new type of classroom or education space. This problem I will try to solve in my next case study V. Interpretation of the Hunt Library in North Carolina State University campus in the USA. I was awarded the Fulbright Scholarship at NC State for six months in 2021.

Safety needs in VR - protection from elements, security, order, law, stability, freedom from fear. In VR we can protect our VR worlds from other avatars by creating special access to the 3D online world in Neos VR selecting people who we want to allow to our world. It depends on us with who we want to share our virtual space and who we want to meet there.

Love and belongingness needs - Examples of those are: friendship, receiving and giving affection and love. Affiliating, being part of a group (family, friends, work). In Neos VR and other social VR platform, you can create a community of friends, virtual relationships. Find new friends or love. It is possible to design spaces for meeting friends and family.

Esteem needs - dignity, achievement, mastery, desire for reputation or respect from others (status, prestige).

Now it is usual that virtual profiles have followers, high status, and prestige. Celebrities, models, influencers, actors, singers have rich online virtual profiles. It is also possible to have fans in the Neos VR platform in VR. Also, the type of architecture in VR is possible to design in a simpler way or more fancy fantasy way. An example is a villa or residence, the chateau in contrast to a simple family house in physical space.

Self-actualization needs - realizing personal potential, self-fulfilment, seeking personal growth and peak experiences. This category is more relevant in physical life than in virtual.

Elements of architecture in VR derived from architecture in physical space. Vitruvius Ten books of Architecture and Rem Koolhaas Venice Biennale Exhibition Elements in 2014.

Vitruvius

Ten books of Architecture are for me a perfect reference for architecture in VR. I selected chapters that are relevant for virtual reality spaces.

BOOK I / PREFACE THE EDUCATION OF THE ARCHITECT. THE FUNDAMENTAL PRINCIPLES OF ARCHITECTURE. THE DEPARTMENTS OF ARCHITECTURE. Education of architects in VR should be according to me in architecture and art, but also design computing and IT. Vitruvius stated that architects had to

have an education in Arts and technical fields and science. As an architect for VR, should we also work with: Order (in Greek τάξις), Arrangement (in Greek διάθεσις), Eurythmy, Symmetry, Propriety, and Economy (in Greek οικονομία). We can design the VR worlds online with the arrangement and economy in NEOS VR. We can think of new types of functions, activities in VR online worlds and design that space according to this new function. We should design VR worlds with aesthetic ambitions, a similar statement that Vitruvius writes in his books. Different virtual worlds in VR can represent monofunctional but also multifunctional VR spaces.

BOOK II THE ORIGIN OF THE DWELLING HOUSE. ON THE PRIMORDIAL SUBSTANCE ACCORDING TO THE PHYSICISTS.

What was the first dwelling house? What was the first matter? We can ask: What was the first VR architecture? Maybe the one used in VR games or VR architecture used for first VR meetings. We can define new types of buildings, VR architecture for different actions, functions. What was the first matter in the virtual world? Well, there is no matter, just computer simulation.

BOOK III ON SYMMETRY: IN TEMPLES AND THE HUMAN BODY.

We can design a temple for meditation for praying in VR in any religion. Spaces in VR can be programmed and interactive. VR architecture can have multiple functions and be changeable. Avatars in VR worlds are usually in the size of the human body, but avatars can change the scale to giant and small sizes. It depends on how we set the avatar.

BOOK IV THE ORIGINS OF THE THREE ORDERS.

We can learn from Vitruvius. How to design architecture according to a body? The avatar's body can be different from a human. So, the proportions of VR architecture are less related to the human body. There will be some types of VR architecture, forex., implied by built structures, art, nature (like biomorphic VR architecture).

BOOK V THE FORUM AND BASILICA.

Vitruvius writes about harmony, theatres, music in architecture. We can add sound to 3D spaces in VR. There are parties in social VR network Neos VR, group gatherings of avatars who can observe in VR a video of opera. In VR, there are possibilities to design theatres. As architects, we can learn from public space in VR from this chapter. COLONNADES AND WALKS.

BOOK VI. HOW ROOMS SHOULD BE SUITED TO THE STATION OF THE OWNER. As designers, we can create VR architecture for clients, for private or public use: FARMHOUSE, THE GREEK HOUSE. VR architects can learn from principles of built historical or contemporary architecture. But they should never copy built architecture.

BOOK VII FLOORS.

CEILING AND WALLS. All of them have similar attributes in architecture for VR. The floor's ceilings and walls can have material and texture. Vitruvius writes about materials and colours for painting walls and ceilings. VR architects can design materials and colours of VR architecture in a 3D program.

BOOK VIII

Water is also an element that can be made in VR but has only aesthetic importance.

BOOK IX THE ZODIAC AND THE PLANETS. THE PHASES OF THE MOON. Architects designing VR architecture should think about the universe and spacetime to add virtual time for new virtual worlds to coordinate meetings in VR for users of NEOS VR easily. VR architect creates virtual worlds, which means he sets up the gravity, sunshine, spacebox, another lighting. He builds VR architecture. He can add elements like water, fire, weather like a snowstorm, sandstorm, basically particle system elements.

BOOK X Defence type of buildings are not relevant in VR, but there exist some protections like you cannot go through a 3D object, or you cannot enter private VR worlds in Neos VR, you can invite some friend avatars to your VR world.

Elements

In the book Elements from 2014 Rem Koolhaas and his team are writing about the history of each element of architecture: Wall, Floor, Ceilings, Elevator, Façade, Roof, Floor, Door, Window, Balcony, Corridor, Fireplace, Toilet, Stair, Escalator, Ramp.

It is a very new approach to think about each element of architecture separately and give a compact knowledge about that element. In virtual reality, I can also focus on VR elements of Architecture for VR. Of course, the conditions like flying of avatars in VR or moving through 3D objects in VR requires different parameters.

Selected architects from the 21st century who use design computing as architectural design process: Greg Lynn, students of Greg Lynn group, iheartblob.

I found a blog on Instagram created by Greg Lynn's students that are designing and exploring new objects, blobs. On their Instagram, they present renders from Unity, also augmented reality videos, overlaying existing real spaces. To me, this kind of experiments is ready to be transformed into virtual reality. Iheartblob is creating their projects in the Unity VR program. These blobs could become new architectural spaces for virtual reality accessible and visited by avatars in NEOS VR.

Greg Lynn is the essential person for the development of computer-aided design in architecture. In the 90s he wrote a book about his projects designed in a computer called Animate Form. Greg Lynn saw the great potential in augmented reality technology for architects and promoted HoloLens in 2016. In Animate Form, Lynn explains the word animation and motion.

Architects from 20th century who explored architectural utopias and fantasies.

In MoMA, there was an exhibition in 2008-2009 about New York plus other locations focused on experimental and utopian architecture since the 1970s. I love the plan of Dreamland (1977) and the drawings of the book Delirious New York (1978) by Rem Koolhaas and Madelon Vriesendorp.

Utopian projects of cities of 20th and 21st century.

Buckminster Fuller – Dome Over Manhattan 1960

I choose this project from 1960 because of an experiment to close a city into a dome structure. Buckminster Fuller Dome Over Manhattan is testing the idea to build a climate-free city.

Yona Friedman -Bridge City 1960

The Bridge City by Yon Friedman and Eckhardt Schultze-Fielitz was the bridge over the English Channel. They filled this megastructure by residential, commercial, and industrial units.

Paolo Soleri – Mesa City 1960

Mesa City by Soleri reminds me of a structure growing like mushrooms and

plants from the ground. What is interesting is how this architecture is more weight on the top than at the bottom.

Kiyonori Kikutake -Ocen City 1960

Ocen City by Kiyonori Kikutake was a Metabolist proposal for a floating city of two concentric rings.

Archigram – Plug-In City, 1964

“Plug-in City is visionary creations produced in the 1960s by the radical collaborative British architecture group Archigram, of which Cook was a founding member.” (MoMA 2012).

Then the Superstudio had a project Continuous Monument, Rem Koolhaas Exodus. These utopian and visionary ideas were a significant topic in the sixties. Research of current student projects at AA and Bartlett School of Architecture. The student from Bartlett created an Instagram account with the hashtag #videogameurbanism. Student of Bartlett designed Videourbanism projects, not for construction, but only virtual existence.

Selected artists and their artworks from the 20th century focused on the interpretation of architecture, cities: František Kupka, Zdeněk Sýkora, Maria Helena Vieira da Silva.

František Kupka

His interpretations of architecture were impressive abstract structures painted on canvas. His painting, Reminiscence of a Cathedral 1920 creates the illusion of vertical space with floating small spaces around.

Zdeněk Sýkora

Zdeněk Sýkora is known for his innovative way of how he used computers for the creation of his paintings.

Maria Helena Vieira da Silva

she was a Portuguese abstractionist painter. She was part of an artist group that we call Art Informel. When I visited Árpád Szenes-Vieira da Silva Foundation in Lisbon, I was amazed by the topic of her paintings, the interpretation of cities. She interpreted New York or Amsterdam, many times also Paris, where she also lived.

2. CÍLE DISERTAČNÍ PRÁCE/OBJECTIVES OF THE DISSERTATION

“Can architecture be digital?

Architecture is the process by which the organisation of activities in space is defined...Physical or virtual...

Vincent Guallart

The goal of this dissertation is to present new possibilities that are now opening for architects and artists. Architects, artists and VR, IT specialists, engineers would design VR architecture. I want to show that we need collaboration between those professions. We experience growth of need for online meetings. 2D internet exists, it is possible to enjoy so many websites with esthetical designs. 3D internet in virtual reality is still at the beginning of its evolution. Investments in VR technologies are growing example: the Facebook company designs **META** project for VR and AR meetings of avatars. META company is now not searching for architects to join their team. The company is searching only for programmers and game designers as creators of the new metaverse. In my opinion, architects should be involved in creating VR spaces. Because it is the job of architects to organize activities, it doesn't matter if it is physical space or digital space.

Another goal of this dissertation is to show the history of virtual reality and VR technology with its application in artistic and architectural fields.

3. METODY ZPRACOVÁNÍ/PROCESSING METHODS

Methodology

I work mainly by using the method research by design, I am searching for supporting materials in literature, I use logic induction and deduction. I am comparing the design guidelines from Vitruvius Ten Books on Architecture and the possibility of designing architectural and virtual worlds in NEOS VR. I try to define new elements and new functions for Architectural and Artistic Spaces for VR. I look for supporting materials in the history of art and architecture that shows evidence from the theory of architecture in history from Vitruvius book De Architectura. I use a recent book about elements of architecture from OMA/AMO, Rem Koolhaas Elements, the result of this research was shown on Venice Biennale in 2014.

For the research purpose, I create 3D models, renders, digital collages, models in virtual reality and animation. I try to verify my principles, the hypothesis, and the research questions. My findings are compared with recent research in the

field of contemporary digital art, contemporary digital architecture. By my methods, I would like to find new meanings of the word architecture and define Architectural and Artistic Space Through Virtual Reality, VR Architecture in the metaverse.

4. VÝSLEDKY/RESULTS

CASE STUDY I. Title: MAGIC FLOWER

Type of results: Digital 3D model in Rhinoceros, renderings, digital collages, my first 3D object in virtual reality and my video as a screen capture in VR. Functional virtual reality world with 3D object Magic Flower in NEOS VR. NEOS VR is a creative social VR online platform. Anyone can visit NEOS VR online in the body of avatar in virtual reality.

Topic: I wanted to create imaginary fantasy worlds with organic shapes and the small 3D object that would be in the size of the tall gallery room. I wanted to test spaces that are not possible to inhabit. I designed organic shapes without the floor and roof where you can fly around just like an insect around the flower. From that, I derived the name Magic Flower.

Design Process: Step one – I was the be inspired by film Alice in Wonderland, the magic garden. I wanted to create structure, 3D object that would look like a massive flower and avatars in virtual reality would fly around like insects. I used stems instead of flowers on top. I designed cocoons. The reason was that cocoon can offer an intimate space. The situation when the butterfly is waiting to come out. Isolated rooms in the cocoons are small. Rooms contrast to the open spaces around the Magic Flower. Because we are in VR, flying avatars can inhabit all those spaces. Structure: Stems and cocoons, Cocoons are constructed from surfaces by using loft from closed polylines. Colours: simple grey stems and colourful cocoons like blossoms. I used my textures for cocoons from my previous artworks, 2D digital collages. Each digital collage has it's own personal story that is inspired by my life and dreams.

Composition: I designed one magic flower that grows from almost one spot.

Size: I wanted the size of the flower to fit into a virtual gallery in the size of a large room. I redraw a shape of the cocoon of a butterfly in Rhinoceros. I created surfaces from closed boundaries using the loft command. I duplicated, transformed, distributed and positioned the cocoons. I designed stems for cocoons to relate them to the ground. I textured cocoons. I worked with

colourful textures to imitate the colourful magic garden. I worked in 2D with the renders, and I created digital collages.

Evaluation: I wanted to design spaces, capsules, cocoons that would be inhabited by avatars in virtual reality. I simplified the complicated 3D model, digital artworks, and collages that I was creating before. I wanted to explore the export of Non-uniform rational basis spline (NURBS) and mesh geometry into virtual reality. It was a long process for me. In 2016 when I created the first 3D models in Rhinoceros, the NEOS VR was not yet developed and ready to use. The NEOS VR course started in February 2019 at the Faculty of Information Technology, CTU Prague. For me, it was adventure and dream-come-true, because I could suddenly enter and immerse myself my digital visions and dreams.

CASE STUDY II. Title: COCOON FLOWER IN THE CITY

Type of results: digital 3D model in Rhinoceros, renderings, digital collages, 3D model of the computer-generated city and massive flower cocoon statue in Blender, animation in Blender:

<https://www.youtube.com/watch?v=gOjlfhwnvbE>

The following result is the functional virtual reality world with a 3D object of the large flower growing from 3D computer-generated city in NEOS VR. NEOS VR is a creative social VR platform that anyone can visit online in the body of avatar in virtual reality. Cocoons in the animation from Blender are moving, floating in the sky. I didn't transform this type of movements into NEOS VR yet.

Topic: To test tall fantasy cocoon structure existing in the context of computer-generated architecture. This case study is about how we feel in the body of an avatar in heights about 300 meters. In human life, we rarely get the chance to experience living in an attitude like this. We cannot inhabit the sky every day like it is possible in virtual reality. The 3D object Cocoon Flower would have similar height as a wind turbine in Gaildorf in Germany 264m. I designed organic cocoons without the floor and roof where you can fly around and spend some time inside these giant cocoons that are floating in the virtual sky. The difference between the first case study Magic Flower and Cocoon Flower in the City is mainly the scale and the experience of an avatar seeing different perspective from above the virtual city. Gigantic cocoons are spaces where avatars can meet, relax, but mainly communicate together.

Design Process: My first step was: I derived the second case study from the first case study MAGIC FLOWER. I was testing a much larger scale. I wanted to design a large 3D object that would look like a massive cocoon flower. Avatars in virtual reality can fly around the cocoons in the sky. Avatars have with the view to the computer-generated city with skyscrapers that sprawl on the ground. The stems and cocoons that are butterfly nymphs inspired me. The 3D cocoons show colourful environment with vibrant textures. Avatars in a bigger group can inhabit this space.

During the design process, I created in collaboration with Jindřich Ráftl, his animation team and the consultant for VR Marek Kulkovský, in this short film, we described an idea of green travelling in VR. The main idea is people will be using virtual reality to visit cities in the future in the body of an avatar. People will travel less in real life. It will lower emissions caused by fuels during actual transportation.

Another step was to imagine such a structure in a real city. I choose Barcelona. I did several collages in 2D with Barcelona background, because I love Antoni Gaudí's architecture. I had ideas that cocoon structures could grow from green areas of the city concerning existing green parks and trees. I tested sources from real sites as a source of inspiration for the virtual environment, for example in case study Barcelona. I used Gaudí's architecture like Casa Batlló, Park Güell. My structures were in 3D, but results were only 2D collages, images. I wanted to travel to Barcelona and try to research the essence of Barcelona. I designed my interpretation of Gaudí's architecture. I discovered a new type of architectural and artistic space for virtual reality. That idea I developed in my third case study.

Evaluation: I wanted to design huge spaces: capsules, cocoons. Avatars would inhabit these cocoons in virtual reality. The size of them is a scale of a skyscraper city. I imported the new 3D model to the Neos VR. I tested the depth of the space if you are in the sky in the cocoon and you have a view of the city below you. In ordinary life, we don't have a chance to spend time in such heights as 360 meters. Another challenge was to explore different textures on cocoons with colourful images and patterns. We don't experience such organic spaces full of colours.

This case study concludes that I should interpret and reinvent a new type of environment: VR architecture, Architectural and Artistic Spaces for Virtual Reality. In Mel Slater's lecture, I want to highlight the idea that we don't need to simulate reality in VR. We need a new paradigm. **"A new VR paradigm must emerge from practice and CREATIVITY."**

Mel Slater 2017. I am searching for new evidence of architectural and artistic activities in the metaverse. In December 2021, I saw a video created by Zaha Hadid architects. Patrik Schumacher wrote about this project Cyber Urban Incubator that shows glimpses of the Liberland Metaverse.

CASE STUDY III. Title: INTERPRETATION OF CASA MILÀ IN BARCELONA INTO ARTISTIC AND ARCHITECTURAL SPACE FOR VIRTUAL REALITY.

Type of results: digital 3D model textured in Rhinoceros, renderings, digital collages, 3D model textured in NEOS VR. Static functional virtual reality world with the possibility to fly around the model and through the 3D model. NEOS VR is a creative social VR platform, that anyone can create an account and visit online in the body of avatar virtual reality worlds and create their virtual worlds.

Topic: I was testing static complex 3D structures in VR. I was inspired by Antoni Gaudí's Casa Milà on the site was Passeig de Gràcia in Barcelona. This case study is about shapes and colours in different spaces that we experience in human life rarely get the chance to experience. We cannot inhabit spaces, that are floating in the air without floor or ceiling or places, that are coloured and shaped organically. Now it is possible all that in virtual reality.

Design Process: I tested complicated static spaces in a 3D model from Rhinoceros with exciting colours and organic shapes inspired by architect Antoni Gaudí and artists Joan Miró and Salvator Dalí. In 2019 I used the NEOS VR program to create a virtual world with new textures in VR.

Evaluation: I wanted to design my interpretation of existing sites and architecture and use data from reality to transform them into architectural and artistic spaces for virtual reality. I wanted to work with NEOS VR and test the complicated shapes in a static environment. Also, the next challenge was to explore different textures on organic shapes in NEOS VR. In our life, we don't fly in spaces without floors and roofs, spaces without gravity. I tried to interpret and reinvent new types of VR architecture online: Architectural and Artistic Spaces for Virtual Reality. My floating structure can behave as an environment where avatars can meet, interact, work and in future in NEOS VR also shop. It is a small step in designing a Metaverse, I wanted to invent a new type of architectural virtual reality world. Now the IT professions are taking over the architectural design in VR. Sara Eloy wrote on social networks:

"Fed up with computer scientists doing architecture research without architects. The amount of bullshit in papers about what is architecture design"

is annoying and killing off what is a quality designed space. While most architects are still in an autistic way away from this development, computer scientists, alone, will take over and the consequences are unpredictable, starting by automatically designing buildings becoming badly designed. All this current talk is about multidisciplinary and, at the end of the day, no multidisciplinary. Too much speed in these times and few want to take time to think well.”

CASE STUDY IV. Title: INTERPRETATION OF ELAVADOR SANTA DA JUSTA INTO ARTISTIC AND ARCHITECTURAL SPACE FOR VIRTUAL REALITY MEETINGS.

Type of results: digital 3D model textured in Rhinoceros, renderings, digital collages, 3D model textured in NEOS VR. Static functional virtual reality world with the possibility to fly around the model and through the 3D model.

Topic: I spend almost two months in Lisbon at the ISTAR-Information Sciences and Technologies and Architecture Research Centre (ISCTE-IUL). ISTAR had the equipment for virtual reality. I could test my projects in NEOS VR, with a VR headset. My visiting research was under the supervision of Professor Sara Eloy. I was searching for the essence of Lisbon. Of course, Lisbon is a city full of hills. There are old yellow trams and elevators helping people to move uphill and downhill in the city centre. Today most of the trams and elevators are tourist attractions. One of them is Elevador de Santa Justa. It is a lift transporting people from the Rossio area to Chafariz do Carmo near Praça Dom Pedro IV square in Lisbon. Elevador de Santa Justa is made of iron with filigree details built-in in 1902. The history of the surrounding area: In November 1755, there was an earthquake in Lisbon, there were fires everywhere in the city. After that, a tsunami came. This combination of catastrophes destroyed most of Lisbon.

Design Process: My design process tested how to organize movements in 3D space in VR. The idea was to design simple moving floors -miradouros in VR and static environment down in the ground. In 2019 I used the NEOS VR program. I designed a 3D virtual world with new textures in NEOS, but I did not finish the miradouros interactions. The LOGIX visual programming was for collaboration with the Neos VR specialist.

Evaluation: During my visiting research, I worked with historical plans, maps and photos of Lisbon. My observation of the site was significant. My strategy was to interpret Lisbon, plus the area Baixa Chiado. I created my vision of VR

Lisbon. I derived my 3D models from reality, but I did not copy Lisbon. In virtual space in virtual reality, we are in a different situation than in physical space. The body of our avatar in VR can fly, can teleport to places we need. The essence of moving through the Lisbon centre is walking up and down or using elevators and trams. My interpretation of the elevator Santa de Justa is a virtual statue. This statue is like an arrow that points to the floating levels that represent viewpoints – miradouros. The miradouros are in Lisbon to offer views of the city. This fact returns to my NEOS VR world. If an avatar approaches the floating level with blue tiles, the texture changes and shows some other tiles typical for Lisbon. I wanted to achieve immersive 3D virtual space in NEOS VR. I questioned the boundary between digital art and architectural space for virtual reality.

VR ARCHITECTURE IN THE METAVERSE.

VR SPACES FOR EDUCATION IN METAVERSE/VR CLASSES/

Raleigh, June 2021. Fulbright programme: Visiting Research at North Carolina State, College of Design, Department of Art and Design. Supervisor: Derek A. Ham, PhD. Assistant Professor.

Concept for VR Space: My concept was to create VR classes, spaces for online education in the metaverse, that are accessible in Neos VR. These VR spaces are inspired by the robotic Hunt Library at North Carolina State University in Raleigh in the USA designed by Norwegian architectural office Snohetta. VR Architecture is architecture for 3D spaces, buildings in the metaverse. Architecture should quickly reflect the change that is happening in our digital era. We work and study online on Zoom calls, video conferences with our colleagues. We use online banking, book our holidays online, shop online, we navigate with maps online every day. We are architects, designers, artists. We should design architectural and artistic 3D space in virtual reality, the 3D internet, the Metaverse. Architecture and Art are disrupted disciplines in the metaverse because laws of gravity and statics do not apply here. My concept is to put avatars in the shell that will react on the number of avatars in this space connected online. There will be fixed static part, VR floors and VR walls floating in space reminding of physical classrooms. There will be shell scaling its shape according to the movements of avatars inside.

Type of results: Digital 3D model in Blender, renderings, digital art, 3D object in virtual reality plus video records from NEOS VR and UNITY. Functional virtual

reality world with interactive 3D object in UNITY.

Topic: I want to create virtual 3D space for educational purposes that will be inhabited by avatars online. Something like a temporary online architecture that exists in two different modes. When the architecture is not used by avatars the building would be only a static shell with core VR walls and VR floors, simple surfaces. But this shell would scale when the space would be inhabited by more avatars in VR. Avatar simplified to the sphere if he would approach the Shell the Shell would scale, grow away from the sphere.

Design Ideas: Step one – I was the be inspired by the architecture of Hunt Library and the film Ghost in the Shell. I loved the colourful shining spaces with AR advertisements in the city. I wanted to use as many colours in this project as possible. I wanted to create structure, 3D object that would look like a massive shell and avatars in virtual reality would fly inside and create the shape of the interactive shell. I used static floating floors and walls that I took from the shapes of floorplans of the Hunt Library. I designed intuitively the shell of the space around the floating floors. The reason was that shell can offer an intimate space, but it depends on the number of users that would be inside the shell. The shell is transparent mostly but, in some areas, there are textures with colours. I wanted to create space as light as possible but colourful.

Structure: Horizontal thin floors, vertical thin walls with monochrome colours. Shell is created in Blender by sculpting from polysurfaces, this polysurface has texture with colours taken from the Hunt Library and I also used a alpha channel to create transparencies.

Conditions, Type of Interactions for programming the Interactive Shell:

I imagine an avatar is a simplified 3D object in VR, avatars head is a sphere. I would program the Shell of the VR building so the Shell transforms when the sphere gets closer to the shell from inside. The shell would be scaled around the sphere head of the avatar for the distance 3 meters. I choose 3m because in architecture it is a most common level height of the building. It is an idea that more avatars inhabit a shell, VR architecture the bigger the VR space gets. The VR walls and VR floor would remain the same and static because they should represent the meeting and orientation points in VR.

5. ZÁVĚR/CONCLUSIONS

In the past, we can see many inactions between art, cyber art and computer technology. With the development of VR technology, I see the need to design this virtual space. There is a Metaverse online that will be inhabited by millions of people in future. Right now, the attention is on social networks. Most people now have smartphones and tablets. Because the majority of Instagram or Facebook users has a smartphone. We can escape from reality when we get bored: we are standing in a queue in a shop, we are waiting for public transport, we are alone in a cafe or a bar, just because we have our smartphone connected to social networks. Many marketing firms now work with influencers because they promote the goods or places to visit on Instagram. It is a new type of job. TV is no longer so interesting for the young population like it was in the past. TV is used in majority by older people who grew up with TV. My ideas and case studies are about the world that will happen in the future. VR technology and fast computers will be affordable in the next few years for the population. People who now own the computer have the perspective to possess VR glasses. Programmers in the majority use social VR platforms already, but it is not yet mainstream. Mainstream now is to have an account on Instagram or Facebook. Facebook developed Facebook Spaces, recently they invented the online Metaverse, Meta.

Meta is a social VR platform for people with VR headsets. I see there is a problem there. Meta did not use the potential and possibilities to design experimental architectural virtual spaces that avatars can visit. I believe that we will arrange VR meetings, work in VR, shop in VR, go to offices in VR, manage daily duties in VR. All that could help us to gain time and we could use this time to spend real quality time together with family and friends. In addition, if we as architects and artists design these new VR worlds it could be a lot of fun to experience a new type of architecture, Architectural and Artistic Space for Virtual Reality, VR Architecture. My improvements of the current situation, conclusions for further development of science or for implementation in practice. I call our age the “Meta Age”.

My ideas for future: I would like to help to build the metaverse. We live in the turbulent and challenging times. There is still pandemic, coronavirus problem and yet I have to say that this problem of social distancing helped us to understand how much we need online digital spaces for meetings now mostly in 2D screens, but soon in 3D VR spaces online. The Facebook company announced that they are opening about 10000 new job positions to create the

project META. The name is from the word Metaverse.

In December 2021 I searched for new types of metaverses online. I found mostly game-oriented platforms using the crypto currencies. I found also one metaverse for shopping online in 3D space.

For example: Metaverse CEEK, Decentraland, Decentral Games, Illuvium Metaverse, Bloktopia Metaverse. Enjin, Axie Infinity metaverse, Audio Metaverse, Sandbox, WAX. What is the most important is that as user of those metaverses, you can buy and sell assets or NFTs. NFTs are images, videos, music, or assets for games. In some metaverse you can also buy a land a build your own house or project. There is a whole new world of digital files, that you can buy in metaverse. Why to buy assets in metaverse? It is a similar situation like in physical world, we buy things for use and status. We buy hoses to show our status in society. Virtual worlds work similarly.

What is interesting for VR architecture is that architects like Zaha Hadid Architects are involved in metaverse projects.

They created a video in December to show Cyber Urban Crypto Incubator, Liberland Metaverse. It is a project where people trade crypto currencies. It looks like a visualisation of the part of the city with trees, river, green spaces, buildings, towers, all that could be constructed. Avatars walk on the ground, there are staircases, columns. There is a city hall, DeFi Plaza, DeFi Incubator, NFT Plaza, Exhibition. In Exhibition are some artworks hanging in the space without a support. It is a sign of metaverse, but it looks like the only one that shows possibilities without gravity.

Vault – The World’s First Social Currency

The Vault holds some of the most rare and valuable NFTs across blockchain gaming, digital art, virtual real estate and other highly coveted digital collectibles. What Is a Bitcoin Whale? A bitcoin whale is a cryptocurrency term that refers to individuals or entities that hold large amounts of bitcoin. Whales hold enough cryptocurrency that they have the potential to manipulate currency valuations. Blockchain games like for example: Sorare, Gods Unchained, Beyond the Void, CryptoKitties, My Crypto Heroes and Spells of Genesis are games that use cryptocurrency, but they are not metaverse games.

Designing the Metaverse:

I enjoy designing the metaverse. I work in the Neos VR metaverse. I created about 15 virtual worlds in Neos VR for free. Some of them are in the content Hub of Neos VR for avatars to inhabit. I think that the meta is another "strong" developmental phase that will permeate all spheres of life, work, and education. In connection with the world of "meta" I am trying to express my opinions and reasonably in depth show my work to imagine, what waits for us in near future like 10 to 15 years. ... We are experiencing the next historical stage of development of 3D internet and the next and new types of metaverse.

Seznam v tezičích použité literatury/List of used literature in thesis:

ELOY, S., KREUTZBERG, A., SYMEONIDOU, I., ET ATL. (2022). VIRTUAL AESTHETICS IN ARCHITECTURE, DESIGNING IN MIXED REALITIES. ROUTLEDGE: NEW YORK, USA.

GAUSA, M., GUALLART, V., MÜLLER, W., SORIANO, F., PORRAS F., MORALES, J., (2003). THE METROPOLITAN DICTIONARY OF ADVANCED ARCHITECTURE: ACTAR, BARCELONA, SPAIN.

KOOLHAAS, R. (2014). ELEMENTS OF ARCHITECTURE. A SERIES OF 15 BOOKS ACCOMPANYING THE EXHIBITION ELEMENTS OF ARCHITECTURE AT THE 2014 VENICE ARCHITECTURE BIENNALE: FLOOR, WALL, CEILING, ROOF, DOOR, WINDOW, FAÇADE, BALCONY, CORRIDOR, FIREPLACE, TOILET, STAIR, ESCALATOR, ELEVATOR, RAMP. MARSILIO: ITALY.

VITRUVIUS, M., (2001). DESET KNIH O ARCHITEKTUŘE. ARISTA: PRAHA, CZECH REP.

LYNN, G., (1998). ANIMATE FORM. PRINCETON ARCHITECTURAL PRESS: NEW YORK, USA.

WORKAC, (2009) 49 CITIES. STOREFRONT FOR ART AND ARCHITECTURE: NEW YORK, USA.

AUKSTAKALNIS, S., BLATNER D., REÁLNĚ O VIRTUÁLNÍ REALITĚ, UMĚNÍ A VĚDA VIRTUÁLNÍ REALITY, (1994), JOTA. BRNO, CZECH REPUBLIC.

ELOY, S., DIAS, M.S., LOPES, P., VILAR, E. (2015) MULTIMEDIA TECHNOLOGIES IN ARCHITECTURE AND ENGINEERING: EXPLORING AN ENGAGED INTERACTION WITHIN CURRICULUMS. IN FONSECA, D; REDONDO, E (ED.) (2015) HANDBOOK OF RESEARCH ON APPLIED E-LEARNING IN ENGINEERING AND ARCHITECTURE EDUCATION. IGI GLOBAL.

ELOY, S; OURIQUE, L; WOESSNER, U; KIEFERLE, J; SCHOTTE, W; (2008) HOW PRESENT AM I: THREE VIRTUAL REALITY FACILITIES TESTING THE FEAR OF FALLING. IN ECAADE 2018 PROCEEDINGS. LODZ, POLAND.

ACHTEN, H., JESSURUN, J. AND DE VRIES, B. (2004) THE DESK-CAVE. IN 22ND ECAADE CONFERENCE PROCEEDINGS. COPENHAGEN, DENMARK

GARCIA, A. R. AND MARQUEZ, J., VALVERDE VILDOSOLA, M. (2001) QUALITATIVE CONTRIBUTION OF A VR-SYSTEM TO ARCHITECTURAL DESIGN: WHY WE FAILED? IN PROCEEDINGS OF THE 6TH CONFERENCE ON COMPUTER-AIDED ARCHITECTURAL DESIGN RESEARCH IN ASIA. SYDNEY, AUSTRALIA.

DROSDOL, J., KIEFERLE, J. AND WÖSSNER, U. (2003) THE INTEGRATION OF VIRTUAL REALITY (VR) INTO THE ARCHITECTURAL WORKFLOW. IN ECAADE 2003 PROCEEDINGS. GRAZ, AUSTRIA.

BEESLEY, P. AMSTRONG, R. (2011). "SOIL AND THE PROTOPLASM HYLOZOIC GROUNDPROJECT." ARCHITECTURAL DESIGN, ARCHITECTURE PROTOCELL, 81 (2): 78-89.

BENEDIKT, M. (1992). CYBERSPACE: FIRST STEPS. MIT PRESS: CAMBRIDGE, MASSACHUSETTS.

MOMA. [HTTPS://WWW.MOMA.ORG/](https://www.moma.org/)

ART INSTITUTE CHICAGO. [HTTPS://WWW.ARTIC.EDU/ARTWORKS/109529/REMINISCENCE-OF-A-CATHEDRAL](https://www.artic.edu/artworks/109529/remembrance-of-a-cathedral)

MCLEOD S., (2020) RETRIEVED OCTOBER 10, 2020, FROM: [HTTPS://WWW.SIMPLYPSYCHOLOGY.ORG](https://www.simplypsychology.org)

ARS ELECTRONICA FESTIVAL 2018, LINZ, EXHIBITION ABOUT HISTORY OF VR.

SLATER, M. (2017). HOW CAN WE MAKE VIRTUAL REALITY WORK? MEL SLATER, UNIVERSITY OF BARCELONA – EVENT LAB. RETRIEVED 25TH, JANUARY 2022 FROM [HTTPS://WWW.YOUTUBE.COM/WATCH?V=NDI8NVX25AO](https://www.youtube.com/watch?v=NDI8NVX25AO)

SCHUMACHER P. (2021). LIBERLAND METAVERSE – CYBER - URBAN CRYPTO INCUBATOR. RETRIEVED 25TH, JANUARY 2022 FROM [HTTPS://WWW.YOUTUBE.COM/WATCH?V=MANVG1_RPCE](https://www.youtube.com/watch?v=MANVG1_RPCE)

WILSON, M. (2021). RETRIEVED 25TH, JANUARY 2022 FROM [HTTPS://WWW.FASTCOMPANY.COM/90691700/FACEBOOK-WANTS-TO-BUILD-A-METAVERSE-MICROSOFT-IS-CREATING-SOMETHING-EVEN-MORE-AMBITIOUS?FBCLID=IWAR1GGOIQNI3M02WHHOXXFR0A9HYLJ0TGTPHOOV7_0Z0ZOIGY0TQ95YBAKK](https://www.fastcompany.com/90691700/facebook-wants-to-build-a-metaverse-microsoft-is-creating-something-even-more-ambitious?fbclid=IWAR1GGOIQNI3M02WHHOXXFR0A9HYLJ0TGTPHOOV7_0Z0ZOIGY0TQ95YBAKK)

BANTON, C. (2021). RETRIEVED 25TH, JANUARY 2022 FROM [HTTPS://WWW.INVESTOPEDIA.COM/TERMS/B/BITCOIN-WHALE.ASP](https://www.investopedia.com/terms/b/bitcoin-whale.asp)

HAYWARD, A. (2019). RETRIEVED 25TH, JANUARY 2022 FROM [HTTPS://DECRYPT.CO/10998/BEST-BLOCKCHAIN-GAMES](https://decrypt.co/10998/best-blockchain-games)

HAYDEN, S. (2021). RETRIEVED 25TH, JANUARY 2022 FROM [HTTPS://WWW.ROADTOVR.COM/MICROSOFT-TEAMS-MESH-3D-AVATARS-METAVERSE/](https://www.roadtovr.com/microsoft-teams-mesh-3d-avatars-metaverse/)

[HTTPS://NEOSVR.COM/](https://neosvr.com/)

[HTTPS://WWW.CEEK.COM/](https://www.cEEK.com/)

[HTTPS://PLAY.DECENTRALAND.ORG/](https://play.decentraland.org/)

[HTTPS://DECENTRAL.GAMES/](https://decentral.games/)

[HTTPS://WWW.ILLUVIUM.IO/](https://www.illuvium.io/)

[HTTPS://WWW.BLOKTOPIA.COM/](https://www.bloktofia.com/)

[HTTPS://ENJIN.IO/COMPANY](https://enj.in.io/company)

[HTTPS://AUDIOMETAVERSE.COM/](https://audiometaverse.com/)

[HTTPS://ON.WAX.IO/GAMES/ GAMES](https://on.wax.io/games/games)

[HTTPS://ETERNITY.IO/](https://eternity.io/)

[HTTPS://WHALE.ME](https://whale.me)

[HTTPS://WWW.SANDBOX.GAME/EN/](https://www.sandbox.game/en/)

[HTTPS://LANGUAGES.OUP.COM/GOOGLE-DICTIONARY-EN/](https://languages.oup.com/google-dictionary-en/)

[HTTPS://WWW.BHAPTICS.COM/](https://www.bhaptics.com/)

[HTTPS://WWW.ROKOKO.COM](https://www.rokoko.com)

SANSAR, [HTTPS://WWW.SANSAR.COM/](https://www.sansar.com/)

ALTSPACE VR, [HTTPS://ALTVR.COM/](https://altvr.com/)

RECREOM, [HTTPS://STORE.STEAMPOWERED.COM/APP/471710/REC_ROOM/](https://store.steampowered.com/app/471710/REC_ROOM/)

HIGH FIDELITY, [HTTPS://HIGHFIDELITY.COM/.](https://highfidelity.com/)

[HTTPS://WWW.ETYMONLINE.COM](https://www.etymonline.com)

List of dissertation works related to the dissertation/ Seznam prací disertanta vztahujících se k disertaci:

Dissertation Results, Research Contributions, Achievements, Conferences:

- 2021 EAB SYMPOSIUM / Experimental Architecture Biennial vol.5. My Presentation in Online EAB Symposium, 9th August 2021.
- 2020 Presented poster and presentation at the Ninth International Conference on Design Computing and Cognition DCC at the Georgia Institute of Technology, Atlanta, USA online.
- 2018 Presented paper at International Conference Generative Art 2018 in Verona, Italy.
- 2018 Presented paper at Design Computing Conference at CTU / MOLAB in Prague, Czech Republic.
- 2018 Presented poster and presentation in 8th International Conference on Design Computing and Cognition DCC in Milano / Lecco.
- 2017 Presented poster Gaudíán Flowers over Barcelona / Architecture for Meetings in VR, at: eCAADe 2017 ShoCK! Sharing of Computable Knowledge, Rome: Sapienza Università di Roma).
- 2016 Architecture in Perspective conference in Ostrava, Article in the book of abstracts, Ostrava, Czech Republic.

Visiting Research:

- 2021 Fulbright Scholar at North Carolina State University in Raleigh, Department of Art and Design, College of Design, USA for six months.
- 2019 Visiting research at ISTAR-IUL, Information Sciences and Technologies and Architecture Research Centre in Lisbon, Portugal for 2 months.
- 2018 Visiting research at ETSAB - UPC Universitat Politècnica de Catalunya, in Barcelona, Spain for 3 months.

Exhibitions:

Solo Exhibitions:

- 2016 Compositional Archontextures / Fusion space, Prague, Czech Republic.

Group Exhibitions:

- 2021 EAB EXHIBITION. Experimental Architecture Biennial vol.5. My project: Fractal Paradise / Group Exhibition in Fragner Gallery, Prague.
- 2021 REQUIEM / VR EXHIBITION.
My 360 Video was presented during the Requiem 9/11 Event at Czech Center New York, USA, 9th, and 10th September 2021.
Author of the VR video: Ing. arch. Markéta Gebrian. Collaboration with Miroslav Konvalina, the director of Czech Center New York and Anna Kotyza, the director of Requiem.
- 2021 FULBRIGHT 75 VIRTUAL ART EXHIBIT
My Project was presented online together with other Fulbright Scholars from the whole world.
- 2020 Presented at the exhibition by ARTBOX.PROJECTS in Zürich, Switzerland.
- 2020 Presented at the exhibition by ARTBOX.PROJECTS Gallery in Barcelona, Spain.
- 2019 Presented at the Swiss Art Expo by ARTBOX.PROJECTS Gallery. Zürich, Switzerland.
- 2018 Design Computing Exhibition at CTU Prague, Czech Republic.

- 2018 Art for Peace in Neunburg vorm Wald, Germany.
- 2018 Presented at the ARTBOX.PROJECTS Gallery Switzerland during the week of The ARMORY ART WEEKS IN NEW YORK, New York, USA.
- 2017 Presented at the ARTBOX.PROJECTS 1.0 Exhibition in Basel during the week of ART BASEL, Basel Switzerland.
- 2016 FOX gallery, Prague 1, Czech Republic.
- 2015 ART PRAGUE 14th Contemporary Art Fair 2015 Prague 1, Czech Republic.

Grants:

- 2021 Fulbright Scholarship for 6 months, from American and Czech Government for visiting research at NC State University, USA.
- 2021 CTU grant SGS, student grant competition for 2021/2022 for my research of virtual reality spaces for education, FIS: 161 - 1612112E000.
- 2018 Grant from CTU to attend the 21st Generative Art Conference, Exhibition, Live Performances in Verona, Italy.
- 2018 Grant from Design Computing Cognition Conference 2018 to attend the DCC Conference in Lecco, Italy.
- 2016-17 Grant SGS/ Student Grant Competition from CTU to design Smart Structures in Virtual Reality together with a team from FLO|W, FIS: 161-1611608E000.

Winning Projects, Awards:

- 2021 STANISLAV HANZEL AWARD.
I was awarded by CTU Foundation Stanislav Hanzel.
- 2018 THE FIRST PLACE in the competition of all Czech Universities organized by TAČR - CZECH TECHNOLOGICAL AGENCY PRAGUE. Called: "How Do You See It? Perspective/Czech Idea." How does art inspire technology? Team: Jindřich Ráftl, Markéta Gebrian and animators of the video.
- 2016 Inspireli Award 2016 / Semifinalist.

Artist Residency:

2018 Czech Center Moscow by Czech Embassy, topic: to deal with the artistic intervention in Czech House in Moscow.

Lectures:

2021 Architectural and Artistic Spaces Through Virtual Reality, Czech Center New York, NY, USA.

2021 NC State University in Raleigh, lecture for students of Department of Art and Design.

2019 ISTAR - Information Sciences and Technologies and Architecture Research Center, lecture for students about my Case study Barcelona.

2017 EnviroCity Festival: "Floral Vegetable Fantasies", Prague, Czech Republic.

2017 Pecha Kucha Night Zlín: "My recent works", Prague, Czech Republic.

2016 Lecture in Gallery "U Bílého Jednorožce" Klatovy. Czech Republic.

2015 Pecha Night Night Znojmo: "Art and Architecture and programming. " Znojmo, Czech Republic.

2015 Pecha Kucha Night Ústí nad Labem: "It is true in this moment." Ústí nad Labem, Czech Republic.

Future work:

I will collaborate with social VR platforms like NEOS VR and the Faculty of Information Technology. I will continue to develop my topic VR Architecture for social VR platforms. I will apply for grants in art, architecture, technology and science. I will continue to design the metaverse in Neos VR.

Ohlasy / Bez ohlasů a recenzí

Feedback / No feedbacks and reviews known to me.

SUMMARY

In my dissertation I was searching for new ways how to design VR Architecture, 3D spaces in VR for online meetings of avatars in the metaverse. I looked in the history of virtual reality from baroque times until today. I researched elements of VR architecture. I designed five case studies where I created VR worlds in Neos VR metaverse with VR Architecture, architectural and artistic spaces through virtual reality.

RESUMÉ

I, Markéta Gebrian am Prague-based digital artist, architect for virtual reality spaces in NEOS VR, a social VR platform. I started my studies in Architecture and Art at Technical University in Liberec in the Czech Republic.

As an architectural intern, I worked in top architectural offices in Amsterdam, Rotterdam and Paris (Jean Nouvel Ateliers). I studied interior design at Rietveld Academy in Amsterdam with the Freemover Scholarship from the EU. I also studied architecture and urban planning at Ecole Val-de-Seine in Paris. I was awarded a scholarship from the Italian Government to research Borromini and Bernini art and architecture in Rome, I consulted my architectural research at La Sapienza University in Rome.

I completed her master's degree in architecture in 2006 in Liberec.

I worked as an Architectural Assistant Part II in London. As an architectural intern in Steven Ehrlich Architects in Los Angeles, I was in the winning team of the competition for UC Irvine Contemporary Arts Center in California.

My dream was to start my new path in life and concentrate on art. In 2010 I created my first digital artwork using 3D programs I knew from the architectural practice. I have focused my attention on my digital work. I have exhibited as a solo artist in Prague and group exhibitions in 2020 Galegion/Utopian City in Centre for Contemporary Art DOX and Frágnerova Gallery Prague in Experimental Architecture Biennial in 2021.

I had my group shows in Basel, New York, Zürich, Miami with the Swiss art gallery Artbox.Projects.

Since 2015 I have been PhD student at Czech Technical University in Prague, the topic of my dissertation is Architectural and Artistic Spaces Through Virtual Reality. I presented my work at architectural and art conferences: eCAADe in Rome, DCC Conference in Lecco/Milan, Design Computing Conference in Prague, Generative Art Conference in Verona and Markéta participated at the

international conference Design Computing and Cognition with a focus on the application of programming and robotics with my poster and presentation about Interpretation of Lisbon into 3D model in virtual reality in NEOS VR in 2020.

I was awarded an artist residency in the Czech Centre in Moscow sponsored by the Czech Government. I successfully completed two types of visiting research, one was at Escola Tècnica Superior d'Arquitectura de Barcelona, ETSAB, where I interpreted Casa Mila by Gaudí and Eixample urban plan into a VR 3D model. The second research was in the ISTAR-Information Sciences and Technologies and Architecture Research Center, Iscte in Lisbon. I created the virtual world in NEOS VR as an interpretation of Elevador Santa da Justa and the surrounding area in Lisbon.

I have returned from the Fulbright Scholarship in the USA. She was excited to do my visiting research at the College of Design, Department of Art and Design at NC State in Raleigh in North Carolina. I worked under the supervision of Assistant Professor Derek Ham, PhD in Mixed Reality Lab <http://www.mxrealitylab.com/>.

Department Head and Associate Professor of Art + Design at North Carolina State University, Derek Ham is: "Experienced Design Educator with a demonstrated history of working in the higher education industry. Skilled in Analytical Skills, Virtual Reality Development, Computer Modeling & Animation, Design Research, Business Innovation, and Entrepreneurship. Strong education professional with a PhD focused on Design Computation from M.I.T."

ANOTACE

Moje práce zkoumá možné přístupy, možnosti, jak navrhovat VR Architekturu, tj. 3D prostor ve virtuální realitě v metaverzi. VR Architektura je nový pojem, který jsem zavedla, protože se týká architektury pouze pro virtuální využití v metaverzi, online 3 D internetu.

VR Architektura není vizualizace projektu, který se bude stavět ve fyzickém světě. VR Architektura nepodléhá zákonitostem gravitace a statiky jako konstrukce v našem reálném světě. VR Architektura jsou umělecké a architektonické prostory, které lze zažít prostřednictvím virtuální reality v online metaverzi. Součástí mé dizertace jsou uvedeny základní pojmy, nové termíny. Dále pak je zde přehled historie vzniku počítačů, virtuální reality, představení metaverse Neos VR, sociální sítě ve virtuální realitě, téma avatarů. Technologií počítačů se virtuální realitou se zabývám proto, že je to již v blízké budoucnosti téma, které posune náš život od obrazovek počítačů, mobilů a tabletů do nového rozhraní, a to používání VR headsetů, VR obleků apod. Jak je vidět, za poslední rok 2021 vzniklo mnoho nových metaversí, projektů, kde se online dá setkávat v tělech avatarů a pracovat zde, vzdělávat se, hrát hry, nakupovat nebo relaxovat.

Firma Facebook v srpnu 2021 ohlásila, že pracují na vývoji nové metaverze META, která je budoucností 3 D internetu ve virtuální realitě i rozšířené realitě. Odhaduje se, že bude trvat ještě deset až patnáct let, než se plně rozšíří používání metaverze mezi uživateli.

Dotýkám se tématu elementů architektury ve fyzickém tak i virtuálním prostoru, protože VR elementy ve virtuálním prostředí vymezují prostor. Hledám souvislosti v práci architektů a umělců, kteří používají počítače pro navrhování a tvorbu dále se pak zaměřuji na architektonické projekty zabývající se utopií a fantaziemi. Utopie a fantazie architektů jsou snadno realizovatelné ve virtuální realitě v metaverzi. Mým cílem není kopírovat skutečnou, architekturu, města a prostředí ve fyzickém světě. Snažím se najít způsoby interpretace existujících míst a vytvořit nové souvislosti ve virtuální realitě v metaverzi.

V mé disertační práci je popsáno několik projektů, případových studií, a to Magic Flower, Cocoon Flower in the City, Interpretation of Casa Mila in Barcelona into Artistic and Architectural Space for Virtual Reality, Interpretation of Elevador Santa da Justa into Artistic and Architectural Space for Virtual Reality Meetings. První případové studie jsou blízké spíše uměleckým VR objektům, existují ve světech Neos VR. V případové studii z Barcelony a z Lisabonu se věnuji vždy jedné budově a jejímu okolí ve městě,

kteřou interpretuji a vytvářím nové struktury, VR Architekturu pro VR světy v Neos VR metaverzi.

V poslední části mé dizertace najdete projekt z vlastního výzkumu na North Carolina State University, College of Design, Department of Art and Design v Raleigh, USA, kde jsem byla jako Fulbright Scholar na šestiměsíční stáži. Tento projekt je jiný tím, že jsem si osvojila postupy, jak navrhovat VR Architekturu. Metoda zůstává research by design, zaměřila jsem se na jednu budovu, Hunt Library a jde také o interpretaci této budovy. Inspirovala jsem se uměním, architekturou, interiérem, světlem v budově, nábytkem, barvami. Tvořila jsem testovací modely v Blendru a Rhinoceru, přemýšlela jsem o možnosti interaktivní VR Architektury, protože Hunt Library má část s roboty, kteří podávají knihy uživatelům knihovny. Vizuálně je výsledek tohoto projektu VR Architektury velmi abstraktní, dále je zde odlišnot od ostatních případových studií, že jsou to VR Classes, VR třídy, mají edukativní funkce. Jsou zde patrné elementy stěn a podlah, protože vymezují prostor pro VR třídy, pro vzdělávání online v metaverzi.

V závěru mé disertace se objevují srovnání současných metaverzí, zde se jedná často o herní funkci metaverze nebo jde o kasina, nakupování a vůbec tématiku kryptoměn, peněz v metaverzích. Zde je dobré si uvědomit, že lze již dnes v metaverzích kupovat nejen assety do her, ale i pozemky, 3D prostory a domy. Je teď na nás architektch a umělcích, jak budeme navrhovat VR Architekturu pro budoucí 3D internet, metaverzi. Tato práce by měla poukazovat na možnosti spolupráce mezi IT komunitou, programátory a architekty a umělci při tvorbě metaverze.