Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Marwa Al Ka'abi
Student number	5428386

Studio		
Name / Theme	Explore Lab	
Main mentor	Roel van de Pas	Design
Second mentor	Dennis Pohl	Research
Argumentation of choice of the studio	I chose Explore Lab as my graduation studio because of its unique approach that allows students to freely explore their fascinations that aren't addressed by other graduation studios at the faculty through research and design. My personal fascination is about the convergence of physical and virtual realties through architecture and technology, which isn't the focus of any graduation studios at the faculty and that is the main reason why I chose explore lab as my graduation studio.	

Graduation project	
Title of the graduation project	Mirror Realities
Goal	
Location:	Rotterdam South, Netherlands
The posed problem,	The concepts of Cyberspace and the Metaverse have been present since the Mid 80's and early 90's before the widespread use of the internet, these concepts envisioned an alternative human experience in a parallel virtual universe that would entirely revolutionize the way we live. Despite the significant potential of these concepts and the discourse they sparked within various fields, realizing them to their full potential proved to be a task as great as the space race in the 50's that would take decades if not centuries to achieve especially given the state of technology at the time. During the quarantine period of the Covid-19 pandemic our reliance on the internet to connect to the rest of the world, revitalized the interest of big tech companies in the conquest of the Metaverse, kickstarting the experimental

	stages of the metaverse as several moderately scaled virtual worlds oriented around decentralized cryptocurrency, crypto investors, digital arts, gaming, Metaverse architecture and NFTs making them a playground for metaverse architects, artists, designers and crypto investors. Due to the ever evolving nature of technology and the ever growing demand on digitization the digital transition into the metaverse is inevitable as the next immersive 3D internet blending physical and virtual realities. When that future arrives architects will face the challenge of not only designing virtual architecture but also physical architecture in a reality that is infused with virtual elements and altered perception. Before the metaverse arrives we have the opportunity to plan and design it's infrastructure in a sustainable and efficient way. The architect's role in the design of the metaverse is no longer a question of why, but rather how. Especially when we consider the final vision of Stephenson's Metaverse, which presents us with the duality of physical and virtual realities.
research questions and	[Research Question] Main question: How can we facilitate the digital transition into the metaverse through architecture and technology? Sub Questions: What are the physical infrastructures of the internet that are needed to facilitate the metaverse? What are the technologies that are required to simulate a metaverse experience? Who are the actors and content creators that will design the metaverse?
design assignment in which these result.	The aim of the design assignment is to speculate what the infrastructure of the metaverse could like at the scale of Rotterdam and to arrive at architecture that facilitates a metaverse experience through the integration of architecture and metaverse enabling technologies, the

	design assignment is a multifunctional Metaverse Center and the program of the design assignment is based on the research. The main program includes: - A Datacenter that will power the metaverse of Rotterdam. (The digital layer over the city, the digital twins and natives). The data center should be modular and expandable as it could grow with the metaverse. - A content creation/production facility where the creative entities and stakeholders of Rotterdam come together to design the metaverse of their city and performances for the theatre. - A theater oriented towards the metaverse and relies on mixed reality technology to deliver digital/physical performances. The design assignment at later stages will include a masterplan of the virtual layer of the metaverse over the city and the expansive layer of the virtual metaverse. The context of the design assignment is located in Rotterdam south.

Process

Method description

[A description of the methods and techniques of research and design, which are going to be utilized.]

Literature Review: To formulate a theoretical and technological understanding of the metaverse its technologies and ecosystem. To understand the policies and stakeholders involved in the context of the site.

Mapping: To arrive at a spatial understanding of the infrastructures of the metaverse.

Case Studies: To understand the typologies of data centres and derive strategies to implement in the design process.

Literature and general practical preference

Literature References:

Michael Benedikt, *Cyberspace: First Steps* (Massachusetts: The MIT Press, 1992), 1-27.

Patrick Schumacher, *The metaverse as opportunity for architecture and society: design drivers, core competencies (Online:Springer, 2022), 2.*

Michael Benedikt, *Cyberspace: First Steps* (Massachusetts: The MIT Press, 1992), 32.

Michael Benedikt, *Cyberspace: First Steps* (Massachusetts: The MIT Press, 1992), 119-224.

Lik-Hang Lee, Tristan Braud, Pengyuan Zhou, Lin Wang, Dianlei Xu, Zijun Lin, Abhishek Kumar, Carlos Bermejo, Pan Hui, "All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda*" JOURNAL OF LATEX CLASS FILES,* VOL. 14, NO. 8, (September 2021): 1.

Michael Benedikt, Cyberspace: First Steps (Massachusetts: The MIT Press, 1992), 119-224.

Michael Benedikt, Cyberspace: First Steps (Massachusetts: The MIT Press, 1992), 1-27.

Patrick Schumacher, *The metaverse as opportunity for architecture and society: design drivers, core competencies (Online:Springer, 2022), 3.*

Dutch Data Center Association, *Data Center GIDS* (datacenterplatform, 2023).

Raja Koduri, *Powering the Metaverse* (Intel newsroom, 2021).

Steven Carlini, *How Edge Computing Will Power The Metaverse* (Forbes, 2022).

Tristan Braud, Farshid Bjarbooneh, Pan Hui, Dimitris Chatzopoulous, *Future Networking Challenges: The Case of Mobile Augmented Reality (Research gate, 2017)*

Matt Bamforth, *Edge data centers: What and Where?* (STL Partners, 2020).

Matthew Ball, *The Metaverse* (Liveright, 2022).

Gemeente Rotterdam, *Rotterdam Sustainability Compass* (Gemeente Rotterdam, 2020).

Dutch Data Centre Association, S*trategy For Our Digital Future* (DDCA, 2022).

Google, Environmental Report 2022. (Google, 2022).

Bruno Basalisco, Martin Bo, Erki Dahlberg, Morten Hansen, Joshua Brown, *GOOGLE'S HYPERSCALE DATA CENTRES AND INFRASTRUCTURE ECOSYSTEM IN EUROPE Economic Impact Study, (Copenhagen Economics, 2019)*

IEA. "Electricity Consumption – Electricity Information: Overview – Analysis," n.d. https://www.iea.org/reports/electricity-information-overview/electricity-consumption.

Video:

1. Google Workspace. *"Inside a Google Data Center,"* December 17, 2014. https://www.youtube.com/watch?v=XZmGGAbHqa0.
2. datacenterHawk. "What Is Data Center Infrastructure? – Data Center Fundamentals." YouTube, September 15, 2020. https://www.youtube.com/watch?v=FD5cf7uZDhg.
3. Knowledge Base. "Data Center Infrastructure Design Webinar l IEEE LAU Student Branch." YouTube, March 3, 2021. https://www.youtube.com/watch?v=BzJvVBxSEOM.
4. Keiichi Matsuda. "HYPER-REALITY." YouTube, May 19, 2016. https://www.youtube.com/watch?v=YJg02ivYzSs.
5. GOTO Conferences. "Augmented Reality, Beyond Virtual Objects Floating in Physical Space • Morten Birk • GOTO 2018." YouTube, March 6, 2019. https://www.youtube.com/watch?v=cl9A1wWjFEA.
6. Art & Market. "RESET Talk 3 | IRL or WWW: Between Physical and Virtual Spaces." YouTube, January 8, 2021. https://www.youtube.com/watch?v=xMGPYmktmTU.
7. https://www.youtube.com/watch?v=Q572jphxuN0&list=PL-bu3w3rNUpPSBmf89uoESLJttFu0VndH&index=16
8. Art & Market. "RESET Talk 3 | IRL or WWW: Between Physical and Virtual Spaces." YouTube, January 8, 2021. https://www.youtube.com/watch?v=xMGPYmktmTU.
9. Evolve Conference. "Evolve 2018: AR, VR, & the Future of Work." YouTube, May 31, 2018. https://www.youtube.com/watch?v=JFPB6q5mPqo.
10. DigitalFUTURES world. "DigitalFUTURES Talk: Metaverse and

Architecture." YouTube, August 6, 2022. https://www.youtube.com/watch?v=M0BvVb9DvNg.
11. Texas A&M School of Architecture. "The Relationship between Video Games and Architecture." YouTube, May 1, 2017. https://www.youtube.com/watch?v=PvG6H4VS5f8.
12. TPAC Architecture_ Cultural Perspectiveby Rem Koolhaas and David Gianotten." YouTube, September 8, 2022. https://www.youtube.com/watch?v=HUgSS81cdH8.

Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

   Explore lab allows students the opportunity to freely explore their fascinations beyond the scope of architecture, this graduation topic has allowed me to explore different fields like network infrastructure, advancements in computation technology, data, energy, digital production and their relation to architecture. The metaverse is a new frontier for architecture both in the virtual and physical realms, with immense opportunity for exploration and innovation in the design fields and could potentially change our relationship with our built environment and how we perceive it. This makes the metaverse an appropriate topic for explore lab and the architecture track.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

   The project provides an insight of how we could approach the development of the metaverse through understanding the existing physical infrastructure of the internet, metaverse enabling technologies and the direction in which they are advancing. This insight could act as a starting point on how architects could be involved in the development of the metaverse's physical infrastructure and virtual environment at the scale of the city and neighborhood, as well as play a role in bringing together all the different actors that will participate in achieving this vision into a unified space that meets their needs.