Aye Thadar Swe

Emerging Digital Technologies Case Study

February 2024

EMERGING TECHNOLOGIES

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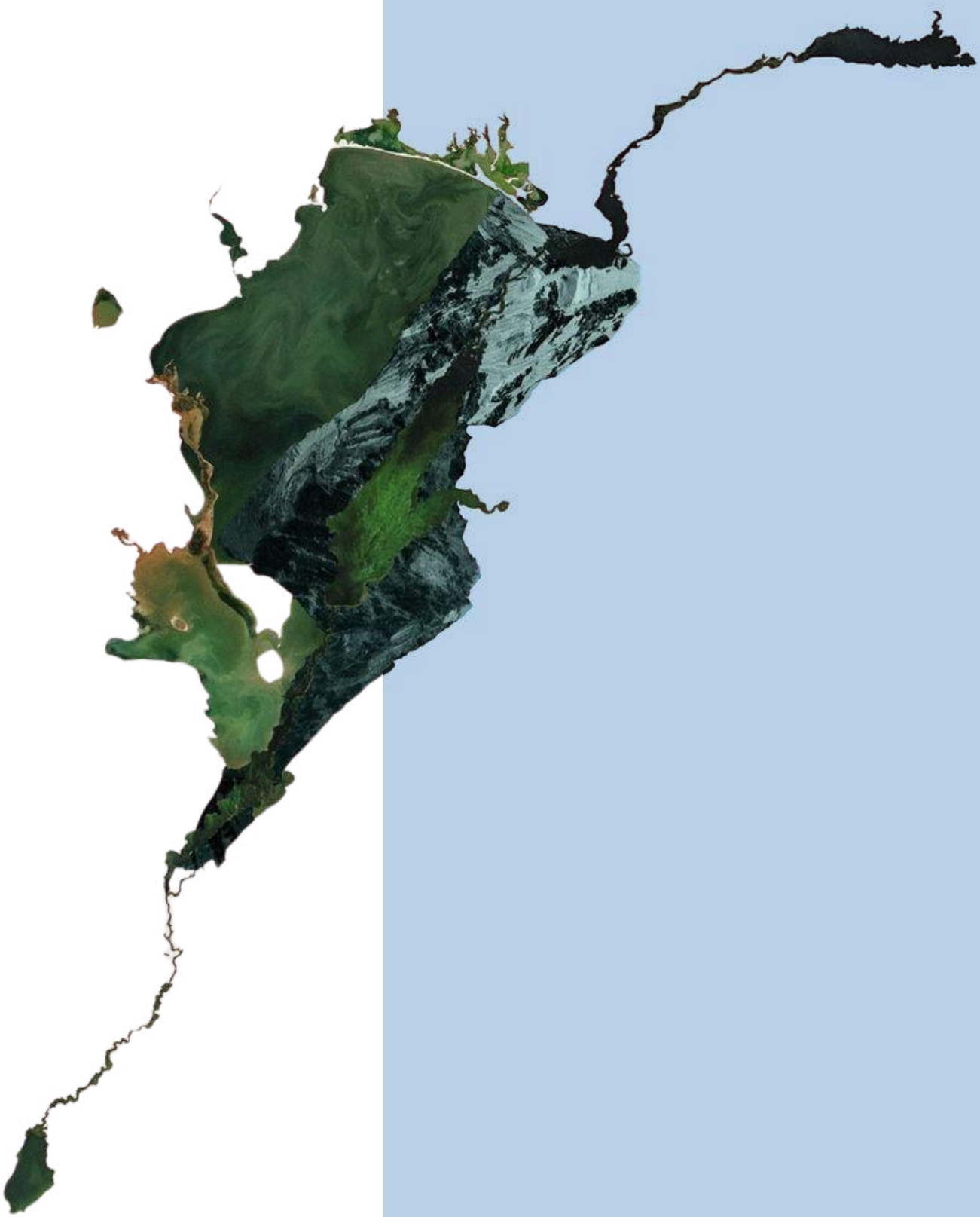

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REVOLUTIONARY?

There's nothing inherently new about machine-learning and assistive technology in today's world. The catch, however, resides in the ***rate*** at which these technologies are advancing to become even more integrated within workflows and creative processes, as well as ***how*** they are being utilised. From new adaptations and improvements over the past few years, the technological leapfrogging has had architects, interior designers and other creative industries at the edge of their seat.

This report and project manifesto investigates, compares and analyses the implications these emerging technologies have had on the design industry in the recent years. Through examining the myriad of current and future possibilities, this report aims to shed light on emerging technologies and a personal project manifesto outlining the implementation of these technologies throughout various design stages.

INTRODUCTION

GENERATIVE AI

The promise made by text-to-image generation of '*if you can imagine it, you can materialize it*' (Fixsen, 2023) has been taking the design community by storm with every advancement. Using algorithms to comb and sift through streams of data to fulfill the parameters of a person's request within a brief span of time, the fusion of human imagination and artificial intelligence holds the potential to revolutionize the way we experiment, conceptualise and execute design concepts.

THOUGHT-TO-EXECUTION DELAY

Architect, Andrew Kudless believes how sharing these fast renderings from day one with clients will allow them to better understand and envision the project, allowing ample time and opportunity to make iterative changes as the project progresses (Dreith, 2022). Similar to the way professionals source inspiration and references from Pinterest and design magazines, generative AI provides the ability to personalise and streamline the process. Although there are numerous Generative AI features being integrated into most creative apps, Generative Fill in Photoshop via Adobe Firefly, Midjourney, DALL-E and Stable Diffusion are gaining traction in the design industry. Users are able to make variations of an existing image as well as quickly convey new and complex narratives, anything from simple to highly detailed prompts with no end to possibilities.

MIDJOURNEY & STABLEDIFFUSION

DRIPPING SPRINGS HOUSE (ANDREW KUDLESS)_2022

MIDJOURNEY

OSLO (MARIUS TROY)_2024

REIMAGINING OSLO'S STARK GRAY MODERN ARCHITECTURE TO A MORE SENSIBLY DESIGNED LANDSCAPE WITH WONDER & EXPLORATION_

ADVANCEMENTS

The initial phase of Generative AI can be determined as generating images from text descriptions by recognising patterns in extensive datasets while the second phase can be determined by how the users are able to modify and alter the outputs through *inpainting* and *outpainting* techniques. While inpainting facilitates the reconstruction of missing parts of an image, outpainting facilitates extrapolating visual data beyond the existing image. By engaging with these advancements, architects and designers are able to gain a more interactive, flexible and dynamic experience.

DALL-E 3 (Early Development in 2021)

The latest version of Dall-E 3, developed and accessed through OpenAI/Chat GPT-4's improvements include higher resolution (12-megapixels), object permanence (consistency), greater photorealism (diffusion model training) and speed (4x faster). It delivers higher prompt fidelity, flexibility and realism compared to its previous versions. (Eldin, 2023)

Midjourney V6 (Early Development in 2022)

Midjourney V6, developed and accessed through a Discord server provides exceptional precision in granular control (color gradients, lighting and shadows), text overlays (accurate in-image text) and conversational refinement (offer feedback and suggest adjustments). V6 delivers improvements in clarity and precision, enhanced artistic styles and faster generation speed compared to its previous versions. (Çıtak, 2023)

Stable Diffusion 2.0 (Early Development in 2022)

Stable Diffusion 2.0 is easier to access and has free web demos, but improved experiences through paid versions requires the installation of required dependencies and environments. The new version includes higher resolution (768x768), depth diffusion (adjust strength and scale) and enhanced upscaling (noise augmentation and seed). With these enhancements, the latest version caters to a wider range of creative needs. (Toolify AI, 2023)

SEAMLESS INTEGRATIONS

From planning alternatives and site-specific conditions to iterations of building design options in 2D/3D and adhering to building regulations, AI tools enable data-driven decision-making and seamless integrations within BIM modelling software. The convergence and synergy of BIM and AI is transforming workflows, and opening up new avenues of innovation. By leveraging AI technologies within this field, BIM professionals are able to optimise design, streamline coordination and enhance overall project outcomes. (Bim & Beam, 2023)

THE TRADE-OFFS

For early-stage schematic design, traditional challenges of manual labor in crafting floor plans include trade-offs between project timelines, maximizing space utilization without compromising usability, and structural and ventilation considerations. To combat this, tools such as Planner5D, Maket AI, ARK and ARCHITEChTURES present a remarkable leap in comprehending design principles while ensuring overall functionality, energy efficiency and user comfort. (Atri Blogs, 2024)

For design development and execution, the ability to simulate real-world conditions, automate repetitive tasks and identify potential design flows before implementation all the while offering real-time visualisation allows professionals to save both time and resources in the long run. The ability to dissect valuable insights from large datasets improves performance and analyse outcomes on traditionally tedious considerations of energy-efficiency and structural integrity.

THE PLATFORM (ARCHITECHTURES) _2024

Maket AI (Founded in 2019)

Maket AI is one of the many generative planning AI tools in the market. It facilitates design professionals with the ability to explore various floorplans, navigate zoning codes, explore diverse styles and make informed decisions around regulatory compliance. The tool also offers a virtual assistant that can provide guidance on materials and costs. Used solely for automating early stage planning, the user-friendly interface and intuitive features eliminate manual tasks. (Maket AI, 2024)

ARCHITECHTURES (Founded in 2016)

Created by Smartscapes Studio, a technology firm focusing on Deep Tech with significant research and development aspect in computational design and AI, ARCHITEChTURES is used by professionals to glean accurate instant insights on optimising site-specific elements. Compared to traditional workflow, their AI technology allows users to make real-time iterations and achieve design objectives and criteria. With integrated automated tasks, the software allows ease of collaboration, analyse configurations and ensures project compliance. The cutting-edge technology enables professionals to stay ahead of the curve and envision new approaches to more sustainable and energy-efficient, time-efficient solutions. (ARCHITEChTURES, 2024)

ARCHITECHTURES_2024

AI & BIM

COMPREHENSIVE SPAT

While both 3D scanning and photogrammetry are ma
analyse and visualise spaces or objects, they dif

Coupled with 3D visualisation software, both 3D scanning and photogrammetry are facilitating professionals in the design industry to create photorealistic representations of their designs. However, the process may differ from equipment being used, integration with BIM software, the level of detail and implementation during various design stages. Equipment may range from hand-held mobile cameras, drones and laser scanning.

CONCEPTUAL: Analyse site conditions & obtain accurate data on terrain, topography and surroundings

SCHEMATIC: Incorporate site data into initial plans to integrate proposed designs with existing environment

DEVELOPMENT: Analyse captured data to identify potential issues or constraints to make necessary adjustments

EXECUTION: Create detailed blueprints, convert data into 3D models to ensure every element is considered for construction stage

3D scanning relies on laser scanners, structured light scanners or time-of-flight technology to map surfaces and geometries. This technology allows a cost and time effective approach for large-scale or remote environments, helping professionals reproduce walk-throughs and virtual tours, while communicating comprehensive data on spatial relationships, architectural features and existing elements.

Photogrammetry captures and stitches a series 2D photos from various angles to create 3D reconstructions. Once captured, measurements and geometries from collected data can be utilised in BIM and various programs, in turn helping professionals make informed decisions in regard to building orientation, topography and surrounding structures. Both methods offer seamless integration with BIM, VR and AR by facilitating more immersive pre-built walkthroughs.

(Hanaphy, 2023)

IAL & OBJECT MAPPING

inly used to obtain a precise Digital Twins to capture,
fer in the underlying technology and workflow.

LUMA AI (Developed in 2021)

Created by Lumalabs, an emerging AI startup in San Francisco, Luma AI sets the standard as one of the most accessible and powerful tools in the industry with a user-friendly interface and advanced AI features. Allowing anyone to generate fast, high-quality and deployable foundation models, the interactive 3D assets can be curated based on any text prompts through *Genie*. Through understanding semantic and geometric relationships, Genie can generate a wide range of assets that can be exported into a variety of software and applications.

Additionally, Luma AI's Unreal Engine NeRF Plugin utilises advanced ray-tracing techniques for game-changing AR experiences regardless of technical abilities. Not limited to just the design industry, the applications are diverse and effective for all creative industries. New features allow video processing, 3D editing and painting opportunities through 3D meshes being exported onto online viewers like MeshLab to adjust and make changes before exporting.

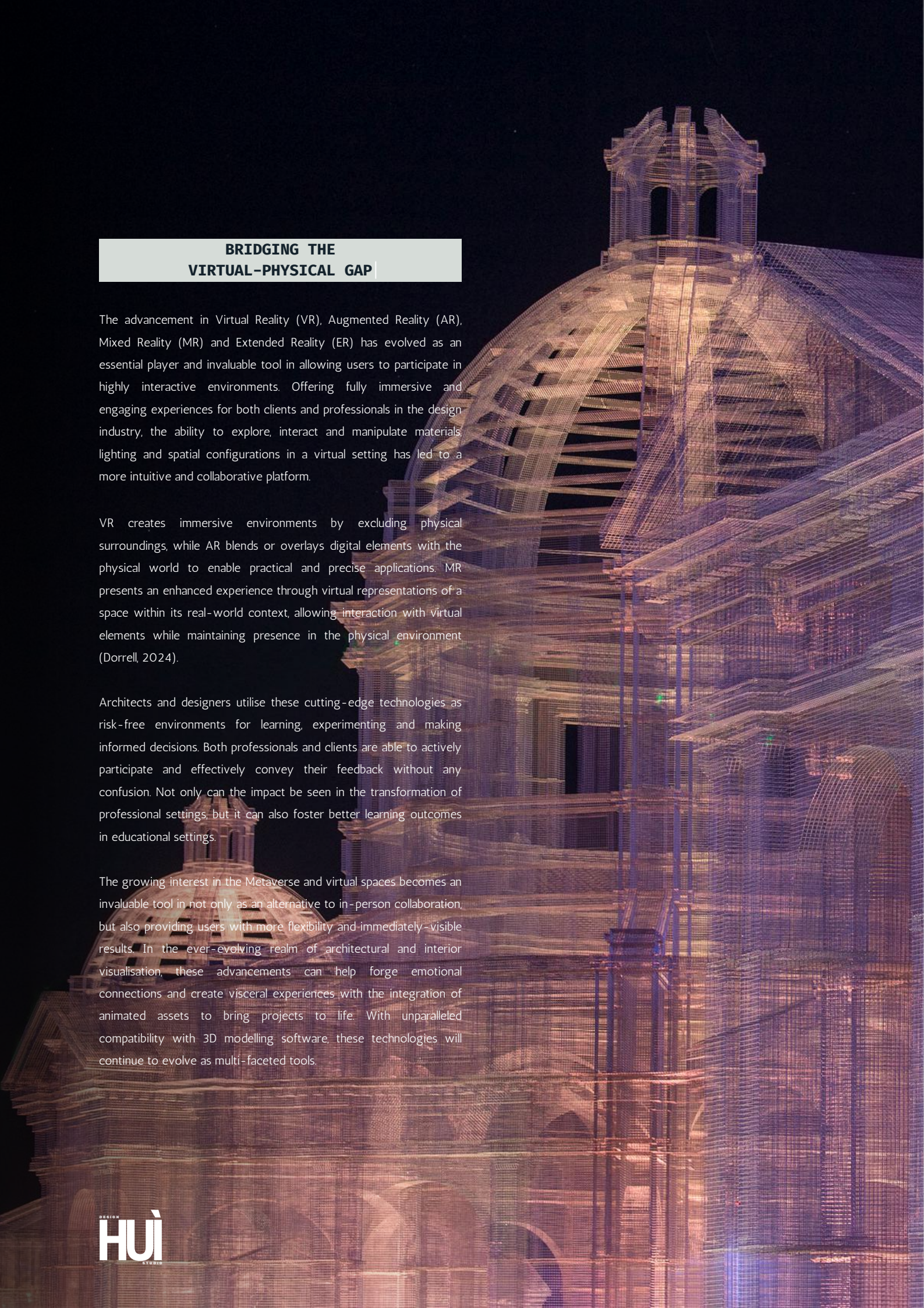
POLYCAM (Developed in 2021)

Polycam provides a wide range of free and versatile tools in capturing physical environments and objects through mobile or drone photogrammetry, generating textures and curating immersive experiences. The latest development include usage for Apple Vision Pro. With fast processing times, professionals are able to create site and architectural plans, floor plans, collaborate and share effortlessly and eliminates the need for consecutive site visits with accurate measurements.

POLYCAM

WLODEKJG (2024)
AN ARCHITECTURAL MODEL OF A LARGE BUILDING
WITH SURROUNDING VEGETATION AND PATHWAYS

SCANNING VS PHOTOGRAMMETRY



BRIDGING THE VIRTUAL-PHYSICAL GAP

The advancement in Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR) and Extended Reality (ER) has evolved as an essential player and invaluable tool in allowing users to participate in highly interactive environments. Offering fully immersive and engaging experiences for both clients and professionals in the design industry, the ability to explore, interact and manipulate materials, lighting and spatial configurations in a virtual setting has led to a more intuitive and collaborative platform.

VR creates immersive environments by excluding physical surroundings, while AR blends or overlays digital elements with the physical world to enable practical and precise applications. MR presents an enhanced experience through virtual representations of a space within its real-world context, allowing interaction with virtual elements while maintaining presence in the physical environment (Dorrell, 2024).

Architects and designers utilise these cutting-edge technologies as risk-free environments for learning, experimenting and making informed decisions. Both professionals and clients are able to actively participate and effectively convey their feedback without any confusion. Not only can the impact be seen in the transformation of professional settings, but it can also foster better learning outcomes in educational settings.

The growing interest in the Metaverse and virtual spaces becomes an invaluable tool in not only as an alternative to in-person collaboration, but also providing users with more flexibility and immediately-visible results. In the ever-evolving realm of architectural and interior visualisation, these advancements can help forge emotional connections and create visceral experiences with the integration of animated assets to bring projects to life. With unparalleled compatibility with 3D modelling software, these technologies will continue to evolve as multi-faceted tools.

DESIGN HUÌ STUDIO

ETHEREA (EDOARDO TRESOLDI)_2018
PHOTO: ROBERTO CONTE

AN EPHEMERAL PUBLIC INSTALLATION INSPIRED BY NEOCLASSICAL AND BAROQUE ARCHITECTURE INVITING VISITORS TO RE-CALIBRATE REALITY AS THEY MOVE THROUGH IT

“THE IDEA OF ESTABLISHING VIRTUAL DESTINATIONS CREATES THE OPPORTUNITY TO ELIMINATE SOME OF THE BARRIERS EXISTING IN THE PHYSICAL WORLD.”

-KAT SCHNEIDER_IA DESIGN INTELLIGENCE 2024

VR_AR_MR

DYNAMIC WORKFLOWS

In relation to all the emerging technologies discussed in this report, the advancements in real-time rendering streamline the continuous loop of feedback between professionals and clients. As the design process involves extensive cycles of trial and feedback, real-time rendering possesses audio-visual and dynamic sensory experiences involving light, space, material and flow. Rather than static or fixed views, the photorealistic scenes simulate real-world different times of the day, weather, shadows and colours. The translation and communication of design is enhanced for all parties involved, with the ability to make instantaneous changes. (FORTES.VISION, 2024)

Real-time rendering is completely transforming the way we learn, work, and interact with various industries. Adopting immersive techniques and elements from gaming and entertainment industries, optimised workflows between modelling and rendering software gives way to more creative control and responsive visuals.

METHODS:

- **Rasterization:** Converts geometric data into a 2D image for quick, real=time user interactions, but can tend to oversimplify complexities of a 3D space.
- **Ray Tracing:** Simulates physical behavior of light to produce high fidelity, stunning levels of realism, reflections and refractions.
- **Shadow & Texture Mapping:** Adds depth through shadows in relation to light sources and enhancing perceived depth
- **Physically Correct Rendering (PCR):** Simulates complex interaction between light and materials
- **Level of Detail (LOD)**: Adjusts complexity of 3D models based on their proximity to the viewer and maintain smooth interaction

MARCO LONDERO
(UNREAL INTERIOR)
_2023

VERSATILITY & INTERACTIVITY

Pioneering the real-time rendering landscape are Unity and Unreal Engine, renowned for their versatility and extensive use in game development. However, Unreal Engine, Enscape, Twinmotion, D5 Render might be better suited to cater to the needs of architects and interior designers through CAD data. These platforms deliver exceptional quality, nondestructive workflows, allow instant changes, accelerate the design process, and host diverse ranges of assets and materials.

Enscape (plug-in) Twinmotion (standalone) and D5 Render (standalone) allows professionals to explore built-in assets, animations and walkthroughs, effects, simulations of time of day and lighting, import or manipulate materials and elevate overall experience. The considerations in choosing which software to use depends on the learning curve, the required hardware, integration with CAD software and fidelity. While Enscape provides the easiest interface to navigate and fast real-time changes, it can be limited in the ability to adjust visual settings as well as effects for assets in comparison to Twinmotion and D5.

Together with Twinmotion, Unreal Engine's unparalleled fidelity and CAD synchronisation capabilities make it a powerful tool for those seeking high visual quality and advanced customisation options. Providing enhanced VR experiences, Unreal Engine's hyperrealistic, cinematic and real-world simulations pushes the boundaries of traditional design visualisation.

REAL-TIME RENDERING

ADVANTAGES & LIMITATIONS

All the emerging technologies discussed thus far have been revolutionising the architecture and interior design industry to unprecedented extents and possibilities. The promising advancements enables professionals to explore a vast range of design variations, digitally replicate environments, streamline processes, and enhance communication. While these technologies offer a number of advantages, they also come with limitations and challenges.

Serving various purposes and applications, considerations for utilising these tools are highly dependent on user needs and preferences, such as the level of creativity, workflows, fidelity, interactivity, learning curves, accessibility, affordability and availability.

ADVANTAGES:

- **Design Possibilities:** Enabling architects, designers and users to explore endless design possibilities efficiently with automated tasks to streamline repetitive tasks
- **Efficiency:** Allowing users to accelerate design processes, saving time and resources with integrations between various software and built-in assets for quicker iterations and adjustments
- **Customisation:** Ability to refine or guide outputs, tailored to specific requirements and criteria for a more personalised and precise design development and execution
- **Risk Assessments:** Identify and assess potential structural or design challenges for more well-informed decisions, reducing the costly mistakes
- **Interactivity:** Allowing professionals and clients to engage with designs through a more holistic understanding and providing sensory experiences and bridging the gap between trial and feedback
- **Accessibility:** With increasing availability of cloud solutions and user-friendly interfaces, the democratization of design tools allow for greater collaboration and creativity
- **Collaboration:** Enhancing collaboration between all stakeholders involved in projects, fostering dialogue and reducing misunderstandings
- **Project Management:** Professionals are able to delegate administrative tasks to bots and virtual assistive AI's, organise schedules, runsheets and allocate responsibilities efficiently
- **Sustainability:** Ability to analyse environmental impacts and site-specific requirements to optimise material and fitting selections

LIMITATIONS:

- **Learning Curve:** Learning to use new technologies may require extra time and effort, rapid pace of advancements may require updating skills, dependent on individual's background and experience
- **Cost:** Investments in emerging technologies can be high due to cost of hardware, software licenses and training which may be a challenge for limited budgets
- **Compatibility:** Integration of new and existing software and workflows may prove to be challenging (i.e. sharing files between different platforms)
- **Accessibility:** Some technologies may require additional or specific hardware to use, this may limit accessibility for those who may not have access to the necessary equipment
- **Dependency:** Heavy reliance on these emerging technologies may lead to lack of creativity and critical thinking or problem solving skills
- **Biases:** Some emerging technologies related to AI may be biased based on the data they were trained on, human interaction and decision making is always critical to the process
- **Privacy:** As with all digital technologies, data or content privacy may raise concerns on copyrighted content, sensitive information or harmful content, the relevant safety guidelines may need to be established

EDUARDO SOUZA (2023)
PROJECT PHOENIX BY MBH ARCHITECTS, FACTORY_OS, KREYSLER & ASSOCIATES, BRIGHTWORKS SUSTAINABILITY AND ECOVATIVE

SOFTWARE: REVIT, CONSTRUCTION CLOUD FORMA @ AUTODESK

LOCATION: SAN FRANCISCO

CLIMATE FRIENDLY SOLUTION PROJECT PRESENTING AN INNOVATIVE APPROACH TO HARNESSING AI AND FORMA TO SIMPLIFY COMPLEXITIES OF DESIGN FOR SUSTAINABLE, EFFICIENT AND SCALABLE HOUSING SOLUTIONS.

SAFETY & ETHICS

Along with these monumental strides, it's essential to address and acknowledge broader implications on cultural, societal, economic and environmental impacts (design curation, the physical vs. the virtual, security measures, discrimination, fair use and copyright infringements). As technology is becoming more and more integrated into daily lives, minds, homes and workplaces, the ongoing implications and conversations around the *intent* and the *extent* need to be highly considered with each advancement.

ETHICAL DOWNSIDES:

- Job Displacement: One of the most prominent and controversial implications of AI replacing human jobs, there is a growing fear and concern over devaluation of human expertise and impact on many individuals
- Homogenisation: As AI rely on algorithms and patterns, it may lead to similar and homogenisation of architectural or interior design, there is a fear of 'sameness' in reduced humanistic elements
- Intuitive Design: 'Architecture is as much an art as it is sa science', emotional responses and intuitive feel of a space are undeniably human and over-reliance on AI or technology may limit personal capabilities
- Accountability & Liability: The question of who is responsible when the technology fails to deliver expected results and minimising risks and biases underscore the need for preventative measures and guidelines

Although some sources and organisations have implemented measures to avoid infringement, provide the ability to change privacy settings, minimise potential for biases and problematic content, the question of who truly possesses the authority and control over these measures remains a critical point of discussion. The value of these technologies depend on *how* it's being used and it proves to be an ongoing challenge in balancing efficiency, ethics and humanity.

(Armela E., 2023) (Real Space 3D, 2024)

USAGE OF EMERGING TECH


DESIGN
HUÌ
STUDIO

“THE CURRENT LIMITATIONS OF THESE TOOLS SUGGESTS THAT THERE’S STILL NO REPLACEMENT FOR A HUMAN TOUCH WHEN IT COMES TO SHEPHERDING A PROJECT TO THE FINISH LINE”

TIM NELSON_ADPRO 2023

The groundbreaking emerging technologies discussed in this report demonstrate the rapid and incredible pace of innovation in today's world. From deep machine learning to artificial intelligence to virtual realities and immersive experiences, these technologies are reshaping industries and transforming the way architects and designers conceptualise, develop, communicate and execute ideas into tangible environments. The possibilities are endless with unprecedented opportunities for growth and advancement.

As some are embracing these advancements to stay ahead of the curve and utilise these tools to their advantage, others are hesitant of the caliber of change. However, these technologies can be perceived as valuable tools professionals can leverage rather than a replacement for human creativity, emotions and authenticity. With limitations in place, human input will always remain essential in the creative process.

LOUIS LIN (SHRINE ACROSS)
_2023

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