REPLY

FROM 2D TO 3D DESIGN PROCESS

A close look at the skills, methods and competencies identified by Reply to effectively address the transition from 2D to 3D design.

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SPATIAL COMPUTING - OVERVIEW

WHAT IS SPATIAL COMPUTING?

After the eras of Personal Computing and Mobile Computing, Spatial Computing is the next era of computing.

Otherwise known as Extended Reality (XR), Spatial Computing is an umbrella term that covers different experiences housed within the reality-virtuality continuum as introduced by Milgram Paul, Takemura Haruo, Akira Utsumi and Fumio Kishino in "Augmented reality: A class of displays on the reality-virtuality continuum" published in January 1994[1].

The continuum covers experiences between the real and the virtual world, introducing a big spectrum of hybrid experiences in-between known as Mixed Reality.

HOW IS SPATIAL COMPUTING CHANGING THE WAY WE COMPUTE?

Enabled by the immense progress in AI computer vision, Spatial Computing is allowing devices to sense the world around them and create spatial awareness which provides more contextual information to the experience.

With technologies like the Real-World Metaverse, a common spatial map can be shared between heterogeneous devices to build connected, collaborative and cross-platform Metaverse apps, where virtual objects anchored in the physical world can be persistently shared over time and across devices. The Metaverse is merging the physical and virtual world to provide a consistent user experience at a 1:1 scale, either with small augmentations of the real world, or fully immersive virtual environments. Through this development, computer and associated accessories will continuously disappear as explicit input modalities, and we will start to see experiences in which we interact with interfaces and digital objects more naturally within the real or virtual world through enabled devices. In the last couple of years, we have already seen this change in experiences like Microsoft Mesh[2] or Reply's Digital Twin Experience[3].

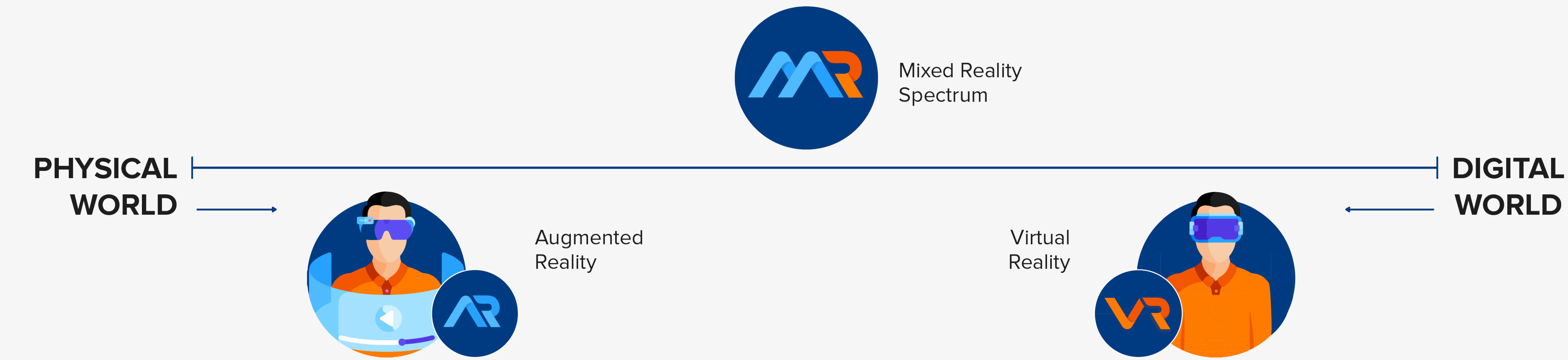


Fig. 1: Reality-virtuality continuum

HOW ARE DIFFERENT KINDS OF EXPERIENCES CHARACTERIZED?

The field of Spatial Computing is large, and different terminologies like AR (Augmented Reality), MR (Mixed Reality) or VR (Virtual Reality) are sometimes hard to grasp, as the same terminology is often used to express different concepts. At Reply, we interpret the different taxonomies as follows.

AUGMENTED REALITY

Via Augmented Reality (AR), the real world gets overlayed with digital content. Through Augmented Reality, something that is not there is imagined and used to extend and enhance what is there.

Therefore, in Augmented Reality the physical world is not shut off: rather, the user is seeing the physical world extended or enhanced via digital content like digital objects, interfaces or sounds. Because of this, Augmented Reality is on the left end of the reality-virtuality continuum, and is supported by mobile devices which include a camera, as well as smart glasses or head-mounted displays (HMD) such as the Google Glass or the Microsoft HoloLens, which could also extend further into the MR spectrum.

VIRTUAL REALITY

Virtual Reality (VR) is the counterpart of the real environment. Located on the far-right end of the continuum, Virtual Reality describes experiences in which the real world is completely blended off, replaced by a synthetic virtual world. Therefore, Virtual Reality offers the opportunity to design completely new experiences – not excluding those not possible in reality – allowing for completely immersive experiences.
Right now, most VR apps use visuals as well as spatial audio, but, as humans have more senses that can be targeted, we could even go further and increase the level of immersion by appealing to other senses. Therefore, haptic feedback and even thermal feedback are being evaluated by Reply to understand the immersion of MR/VR experiences.

MIXED REALITY

Mixed Reality (MR) is the umbrella term for all experiences in the spectrum between Reality and Virtuality. However, since Augmented Reality is its own term with basic augmentation within the continuum, the term Mixed Reality is often used to describe experiences that extend beyond Augmented Reality.

Mixed Reality experiences do not shut off the real physical world completely, but rather enrich the real perception of the world with a digitally created perception by imagining what is not there, in order to extend and enhance what is physically there. Therefore, Mixed Reality enables interactions with both the real as well as the virtual world. This is where, from a design perspective, we can see the difference in Mixed Reality experiences compared to Augmented Reality experiences, often designed for mobile devices. In pure Augmented Reality experiences following the classic definition, the connection to the 2D screen is still existent, especially on smartphones. Interactions are often still following learned patterns from the 2D context or content is still presented as it would be in 2D design.

The more an experience is to the right of the reality-virtuality continuum spectrum, the more these interactions are moved from 2D space to 3D space, and therefore changing the character of the experience provided.

The Microsoft HoloLens, for example, is a Mixed Reality device as it can span the whole spectrum of possible Mixed Reality experiences.

WHAT DOES THE DEVICE LANDSCAPE FOR SPATIAL COMPUTING LOOK LIKE?

The market for devices allowing for spatial experiences is growing, with vendors such as Meta (Facebook), Google or Microsoft driving the market. The number of VR/AR devices shipped worldwide is expected to increase to 68.6 million units in 2023[4].

Devices nowadays include modern smartphones and tablets, as well as new HMD hardware such as the Oculus, the Varjo, the Pimax, the HTC Vive or the HoloLens, allowing for Augmented Reality, Mixed Reality or Virtual Reality experiences.

As these devices get cheaper over time, we can assume that the audience consuming new experiences enabled via Spatial Computing will increase in the long run; this means that the design for these kinds of experiences is gaining importance.

For AR, it is already projected that "by 2025, nearly 75% of the global population and almost all smartphone users will be frequent AR users"[5].

EXPANDING THE 2D DESIGN PROCESS

WHY DO WE NEED TO EXPAND THE 2D DESIGN PROCESS?

The shift towards Spatial Computing comes with great possibilities, but, for designers, also with a big challenge. Spatial computing experience design is shifting from the classic 2D design towards 3D design: designers, therefore, need to learn new methods and skills, as well as get used to new tools and workflows. In the standard 2D design, designers could control what users saw on each step of their journey, and good practices in interface design were well established; the interface, basically, dictated what the user could or should do. In 3D design, designers lose this control.

This is a big challenge which also brings a big opportunity. Designing spatial experiences allows designers to enter a co-authorship with the actual user and let the user transcend the 3rd person.

In 3D design, users are enabled to co-design the experience, as the first-person perspective allows them to control what they want to see as well as allows them to manipulate the experience via real-time interactions. Therefore, depending on which specific technology we are designing an experience for, we are enabled to create new experiences extending the visualizing - or experience reach of users, therefore increasing the immersion and engagement with an experience.

Designing these experiences can seem difficult, as most designers are used to design for 2D, and tools we use nowadays often reinforce our thought-world in 2D. Designing for 3D is not simply mirroring 2D into the three-dimensional space. Designing for 3D rather means expanding the current design process to design engaging experiences that feel seamlessly integrated into the physical/virtual space, matching more natural ways of interaction, and re-considering the fact that our human brain has evolved to deal with a three-dimensional, physical environment around us.

There are already many established design guidelines which help to understand what is needed for this new way of designing experiences for the different devices across the reality-virtuality continuum.

However, these guidelines alone will not suffice as challenges go further. Although they can serve as a starting point and help to understand best practices in design for the different types of experiences enabled via AR/MR/VR, the change from 2D design to 3D design includes many challenges.

Key issue are being able to communicate and document ideas for 3D, rapidly prototype ideas within context, or evaluate and test ideas to find pitfalls early in the process before a detailed technical prototype gets implemented and design issues get discovered after a lot of time and money has been invested.

The shift towards Spatial Computing will soon put an end to simply pulling together some UI elements and arranging them according to known behaviour patterns or other benchmarks. Designing for 3D, requires dedicated interaction design to succeed, as the design for accessibility is also posing completely new problems for designers.

PROVIDER / VENDOR	GUIDELINE	FOCUS
W3C	XR Accessibility User Requirements	XR
Google	ARCore Augmented Reality Design Guidelines	AR
Apple	ARKit Human Interface Guidelines	AR
Microsoft	Design and prototype for Mixed Reality	MR
Microsoft	Kinect for Windows Human Interface Guidelines	MR
Ultraleap	XR Design Guidelines	MR
Oculus (Meta)	VR UX/UI Design Guidelines	VR
Oculus (Meta)	VR Accessibility Design: User Experience (UX) and User Interface (UI)	VR

The shift into the 3D room adds a new dimension, new ways of interactions and new modalities to an experience, which increases the need for inclusive design: the total inclusiveness of these experiences should allow, for example, people with low vision to enjoy these new experiences, deaf people to understand things communicated via audio, or enable physically impaired people in wheelchairs to move around in an experience.

Designers will need to ensure that varying levels of ability, vision, hearing, mobility, perception, cognition speech, neurological abilities or more, are able to access their experiences. Designers will need to learn new methods and skills when it comes to most of the design phases, like “Define”, “Prototype”, “Design” as well as “Evaluate,” to meet these new requirements. Furthermore, they need to gain new knowledge and experience in fields like accessibility.

WHAT DO WE NEED TO EXPAND THE 2D DESIGN PROCESS?

Making the shift from 2D design to 3D design is becoming more and more crucial as technology advances and experiences become more accessible to end customers. In order to shape this new way of computing and establish best practices sooner rather than later, designers need to get involved in this new technology now. The key to doing this successfully is to incorporate new methods, skills and tools to effectively create, communicate, prototype and evaluate experiences, and to extend the current 2D design process.

Reply identified six main methods, skills or areas of knowledge that designers would need in order to successfully expand the 2D design process.

IMAGINEERING

Imagineering (from "imagine" and "engineering") is defined as the implementation of creative ideas in practical form[6-7]. It is a creative visualisation technique that intentionally creates engagement and delight by combining knowledge of artists and engineers, to produce experiential stories which take the imaginary and let it become reality. Imagineering is blending creative imagination with technical know-how, and can help to design fluid and consistent overall experiences by telling a plausible story while also including interaction of the user and different modality levels such as sound or motion to deepen immersion[8]. Imagineering is about allowing a user to step inside a story and live a story, rather than only watch it. To bridge the gap between imagination and reality at Walt Disney, the creative strategy was found making use of a method commonly referred to as Disney Method, modelled in 1994 by NLP expert Robert Dilts[9].

STORYTELLING

As designers are losing control over the camera in 3D, storytelling will become an even more important skill for a designer. Only when a designer is able to create a storyline that grabs the user's attention, will they be able to effectively guide the user through an experience, engage them, enable them to effectively navigate through the experience, and allow them to impact the story flow via learned affordances. This holds true also for experiences other than games, like B2B applications.

STORYBOARDING

In 2D, designers are used to create wireframes and user flows to communicate an idea. In 3D, this communication of concepts also has an important role. However, in 3D, the added third dimension often makes it hard to communicate ideas, as flows need to be communicated differently: since the user is enabled to move around freely within a scene. Classical thinking in the sense of "if-this-then-that" is no longer applicable, as we lost control of the camera and need to communicate and visualise a story. Therefore, designers need to start thinking of the user flow as the story, and a story can effectively be communicated via storyboards as we know them from film making. Only if designers are able to communicate the story via a storyboard on different fidelity levels needed at different stages or occasions, will they be able to communicate the story and achieve a consistent imagination of the scene, which can then be prototyped and tested.

IMPROV / BODYSTORMING

Bodystorming is a design thinking technique modelled on the idea of the well-known brainstorming, allowing designers to physically experience a situation to drive ideation. Like brainstorming, bodystorming uses the body to play through an experience in order to understand what an experience feels like[10]. Where in classical 2D design we could quickly create a paper prototype or clickable prototype, in 3D we need to re-think how we might be able to prototype and evaluate ideas quickly in early stages.

The technique of bodystorming or improvisation can help to play through ideas easily and quickly without the need to create a technical prototype. By playing through a scene and imagining the scene with simple accessories like pen, paper, scissors, tape or straws, designers are able to quickly get a feeling of whether an experience is working out or what needs to be changed in order to meet user expectations. In order to determine whether the workflows you imagined match, these short improvisations / bodystorming sessions, they can be recorded and handed over to an expert for review. Or, even better, they can be executed directly in the presence of the experts, so that the experts can directly give feedback on what needs to be changed to match their workflows and requirements. By directly going into the improvisation / bodystorming part after completing the discovery of what the new experience should be and for whom it is intended, designers could skip any bias that they would get from using classic 2D tools or methods.

PROTOTYPING IN 3D

In current design processes, we often use tools that are especially made for working in 2D. This highly biases designers towards thinking in 2D. In order to break their 2D mindset, it will become crucial for them to start creating spatial experiences directly within 3D in order to produce experiences directly within the desired context. To make the start easier, elements of typical 2D designs, like wireframes or stylistic elements, could be imported into the 3D scene where they serve as a guide for the design process, whilst the design itself happens in 3D. Current tools on the market which are well suited for designing in 3D include ShapesXR or Tvori, which enable designers to create experiences directly within the 3D room. As with ShapesXR, designers will be able to quickly build their designs using primitives directly within the software. Otherwise, designers either have the opportunity to get acquainted with 3D modelling via software like Blender, SketchUp, Maya or Cinema 4D to create their assets, or make use of platforms providing ready-made 3D assets like TurboSquid or Sketchfab.

ACCESSIBILITY / INCLUSIVE DESIGN

As outlined before, the shift to the 3D room adds a new dimension, new ways of interacting, and new modalities to an experience, which increases the need for inclusive design. Similar to 2D inclusive design, where we are designing for accessibility, gender or localization, this should be a consideration in each of our product/feature designs in 3D as well. In 3D, designers will be confronted with more questions regarding accessibilities of the added dimension, as well as new or newly important modalities. Therefore, designers must not only gain further knowledge when it comes to accessibility, but also knowledge regarding new technologies that enable, for example, haptic feedback, hand tracking, eye tracking or voice control, to solve problems with accessibility which could likewise be tested with users.

Many of the guidelines listed previously already cover some aspects. However, accessibility and inclusive design for spatial experiences will be a field becoming more and more important. Therefore, it needs more investigation and research to ensure enjoyable and democratized experiences for everyone.

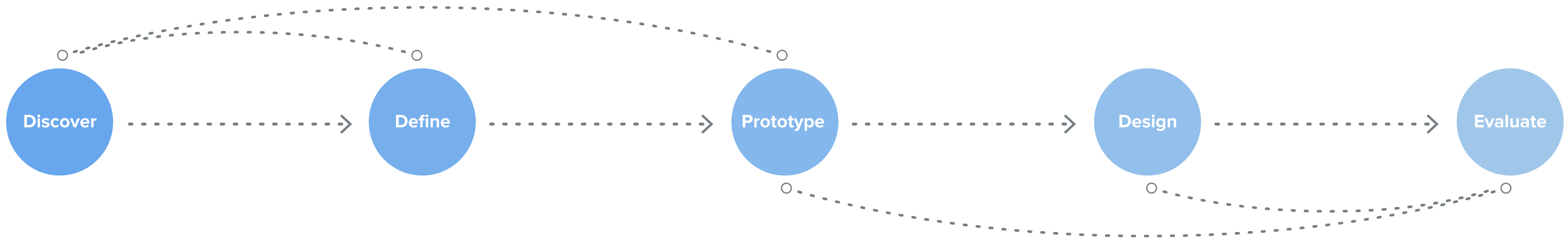
HOW TO INTEGRATE THIS INTO THE DESIGN PROCESS?

Looking at the current 2D design process, shown in the picture below, how can these new skills or methods be effectively incorporated within the new 3D design process?

In an initial concept, imagineering could complement the “Discover” phase to create a design strategy and concrete plan. Storytelling, storyboarding and bodystorming could replace wireframes and screen flows in the “Define” phase, where ideas are now being communicated via low-fidelity storyboards in the early stages of the design process.

During the “Prototype” phase, prototypes need to be built and tested directly in 3D via dedicated 3D tools. In the actual design phase; high-fidelity storyboards are created to communicate ideas in detail, high-fidelity 3D assets needed for production are developed, and guidelines and documentation (storyboards as well as videos showcasing expected behaviour in prototypes) are created, which could be handed over to developers in order to build a common understanding.

During this whole process, it is crucial to consider accessibility throughout all phases: accessibility is becoming evermore important in 3D, as the audience impacted will constantly increase.



Discover
- Stakeholder workshops
- User interviews
- Contextual inquiries
- Expert interviews
- Empathy maps
- Heuristics
- Competitive analysis
- Data analysis
- Imagineering

Define
- Personas
- Goals
- Story
- Affordances
- Task Flows
- Improv / Bodystorming
- Storyboarding

Prototype
- Ideation
- Storyboards
- Mid fidelity 3D mockups
- Interactive 3D prototypes
- User testing
- Concept validation

Design
- High fidelity 3D design/assets
- Interactive 3D prototypes
- Usability testing
- Style Guide
- Annoted Storyboards
- Videos of experiences

Evaluate
- Developer handover
- Design Reviews
- User Testing
- Iterations

● 2D design process ● 3D design process

CONCLUSIONS AND RECOMMENDATIONS

Technology in the field of Spatial Computing continues to develop at a rapid speed, driven by many tech giants.

“The global augmented reality (AR), virtual reality (VR), and mixed reality (MR) market is forecast to reach 30.7 billion U.S. dollars in 2021, rising to close to 300 billion U.S. dollars by 2024”[11] and it is projected that “by 2025, nearly 75% of the global population and almost all smartphone users will be frequent AR users”[5].

Spatial Computing will drastically change the way we compute. Especially for designers, this poses the challenge of transitioning from 2D design to 3D design.

This transition will be key to succeeding in the ever-growing market and to convincing with meaningful, enjoyable as well as accessible experiences.

Making the shift from 2D to 3D design is becoming more and more crucial as technology advances and experiences become more accessible to end customers.
Therefore, it is time for designers to get involved in this new technology, gain first-hand design experiences with it, and try to form it via the implementation of good practices. This, from Reply’s perspective, includes all six relevant areas touching new methods, skills or knowledge as outlined within this report, highlighting the processes that would need to be further tested in practice and iterated in order to establish a smooth workflow for designers and clear communication at each of the phases for everyone in the development team. This would keep the vision and idea for an application, and deliver highly enjoyable immersive experiences to the end customer. This is where our work will continue.

Furthermore, to get started in the field of Spatial Computing and Mixed Reality, Microsoft’s guideline “Design and prototype for Mixed Reality”[12] could be a good starting point.
In addition to design principles and patterns that need to be considered when designing for the Microsoft HoloLens, the guideline provides an overview of the whole field of Mixed Reality, explains core concepts, and outlines resources which might be beneficial to get started.
When it comes to the field of Augmented Reality on mobile devices, Google’s ARCore Augmented Reality Design Guidelines[13] is also recommended. In addition to this guideline, which outlines the core concepts and best practices, Google further offers an app (ARCore Elements) which lets designers experience and test many of the core concepts and best practices directly within their environment[14].

Additionally, the application of inclusive design and accessibility will be key to successfully democratizing this new technology by designing accessible and enjoyable experiences everyone can use regardless of their ability.

A good starting point could be the “XR Accessibility User Requirements”, as provided by W3C, outlining general considerations or the guideline “VR Accessibility Design: User Experience (UX) and User Interface (UI)” by Oculus (Meta), focusing on accessibility for VR[15].

No matter where designers start to make the transition from 2D to 3D design, it is important that they start it now: the shift in computer interaction design is already happening, and the need for dedicated 3D interaction design is omnipresent.

SOURCES

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THE MOVE TOWARDS SPATIAL COMPUTING COMES WITH GREAT POSSIBILITIES, BUT, FOR DESIGNERS, ALSO WITH A GREAT CHALLENGE.

CHOOSE REPLY TO SHIFT FROM CLASSIC 2D DESIGN TO THE 3D PROCESS.