Extended Reality (XR) with ArcGIS
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Overview
VR – Virtual Reality

Being there

Oculus Rift
Oculus Quest
HTC Vive
HP Reverb
AR – Augmented Reality

Interacting with outside world

Smartphones
Tablets
MR – Mixed Reality

Mixed presence

HoloLens

Magic Leap
XR – Extended Reality

Physical Reality
The real world around us

Augmented Reality AR
Overlay of information onto the real world

Mixed Reality MR
Merging of information and real world

Virtual Reality VR
Immersing in a digital world
Positional Tracking for XR
Inside-out vs Outside-in Tracking

**Inside-out**: Cameras on HMD, marker-less tracking of position changes in relation to environment.

**Outside-in**: Cameras placed in stationary locations & markers on devices (HMD & controllers).
Positional Tracking for MR

Inside-out motion tracking, but needs initial position
Global Positional Tracking for AR (and MR)

Accuracy:
- GPS: ~10m
- Wi-Fi: ~1m
- RFID / Beacon: ~1m
- UWB: ~0.1m
XR Devices
... and many more devices, each with different features
Premium VR

- Inside-out or outside-in
- 6 DoF
- High cost, requires PC
- Great graphics, but **cables**

Mobile VR

- Inside-out
- 6 DoF
- Low cost, standalone
- **Limited graphics**, no cables
Special Mention for VR: Oculus Quest

• Standalone mobile VR device that optionally can be connected to a PC with a USB cable (Oculus Link)
  → Mobile and Premium VR in one
• Provides both controllers or hand tracking
Special Mention for MR: Hololens 2

- Standalone MR device with a larger FOV
- Windows MR platform provides many features e.g. spatial anchors, allowing for apps where VR & MR user can collaborate
- Contents (pixels/video) can be streamed from Unreal Engine without cable, allowing also for PC graphics
XR User Interface Concepts
Table-scale aka the “Tabletop” UX

- Common UX pattern for AR, MR & VR
- Collaborative
- Intuitive, people can relate to table
- No motion sickness
Teleporting

- Still the most used locomotion technique in VR
- No motion sickness
- May result in loss of orientation
Controllers

- Fast and reliable
- Complicated to use (like game pads)
- Established UI concepts
- Comfortable

Hand tracking

- Still a tiny bit laggy
- Intuitive
- UI concepts are in its infancy
- Not comfortable (arms need to be up)
XR with ArcGIS
GIS data → CityEngine → ArcGIS plugin for Unity & Unreal → ArcGIS Runtime for developing AR apps

CityEngine VR Experience Premium VR app

ArcGIS 360 VR Mobile VR app

Unity / Unreal Engine for developing XR apps
Use Cases

Simple creation of mobile VR demos for the public
To showcase urban redevelopments to the public, CityEngine users like the City of Zurich are looking for a simple CE-scene-to-VR solution that is easy to use (= one-click publish) and easy to setup (= mobile VR that does not require high-end PC). Planned to be used on trade shows / booths, public show rooms / installation, and architectural competition viewing events.

Quick immersion into design to experience view impact
CityEngine users interested in VR would like to quickly immerse into their 3D scenes to review the design. However they want a simple, iterate-able workflow and not a complicated 3D data pipeline to Unity. Also they want to share the VR experience (mainly for review by peers, not yet by the public). The typical design question that VR can answer better than every other visualization: “How does the new neighboring building impact the view from the balcony?”.
GIS data

CityEngine

ArcGIS plugin for Unity & Unreal

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Mobile VR app

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for developing AR apps
Augmented Reality with ArcGIS Runtime

- Available for production use
  - AR for mobile platforms
    - iOS, Android devices
  - Not for VR or MR

- AR capabilities delivered with:
  - ArcGIS Runtime SDKs for Android, iOS, Qt, and .NET
  - Open source toolkits to work with hardware
Supported Experiences and Use Cases

• **Flyover**
  - Use case: Education
  - Intuitive navigation of a scene

• **Tabletop**
  - Use case: Design
  - Lock scene to a surface

• **World scale**
  - Use case: Inspection
  - Overlay scene on the real world
ArcGIS Runtime
Augmented Reality Demo

https://devpost.com/software/sonderfly
Challenges and considerations

• Your user’s ability and expectations
• Device capabilities
  - AR sensors
  - Positional accuracy
• Data accuracy in 2D and 3D space
GIS data

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New!
Developing with Game Engines

- Premium rendering experience
- Easy cross hardware development
- Existing developer community
- Physics, animation, other effects
ArcGIS integration with Unity and Unreal Engine

- Need a developer solution that targets
  - All XR experiences
  - Any 3D “gaming app” that needs GIS

- Unity and Unreal Engine plug-ins
  - Provide APIs to access ArcGIS services and local data
  - Display in and honor real world/geographic coordinate space
  - Support local and global (open world) experiences
  - Integrate with game engine developer experience
  - Include SDK resources (doc, samples, API ref, demos)
ArcGIS capabilities in Game Engines

- Raster tile layers
  - Display
  - Elevation
- Scene layers
  - 3D objects
  - Integrated mesh
  - Point cloud
- Feature layers
  - Points, lines, polygons
- Operations
  - Geocoding
  - Routing
ArcGIS for Game Engines Beta

- Beta program open for registration
- First beta deliverable Q3 2020
- First production release Q1 2021

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