

EDICULA

Educational Digital Innovative Cultural heritage related Learning Activities

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Bridging the gap between XR community and CH end-users

Anastasios Doulamis

Associate professor of the

National technical university of athens

EDICULA Project: Coordinator, Prof. Antonia Moropoulou



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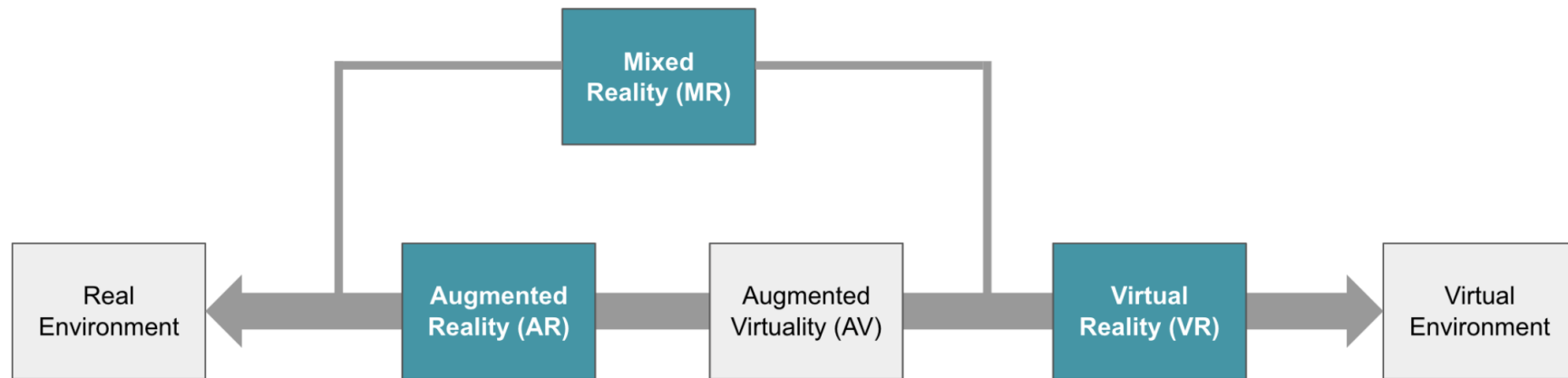
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Extended reality (XR) Technologies

- ▶ XR refers to all **real and virtual** environments, **properly combined together**, where the interaction between human and machine occurs through interactions generated by computer technology and hardware.
 - ▶ Virtual Reality (VR), Mixed Reality (MR), Augmented Reality (AR)

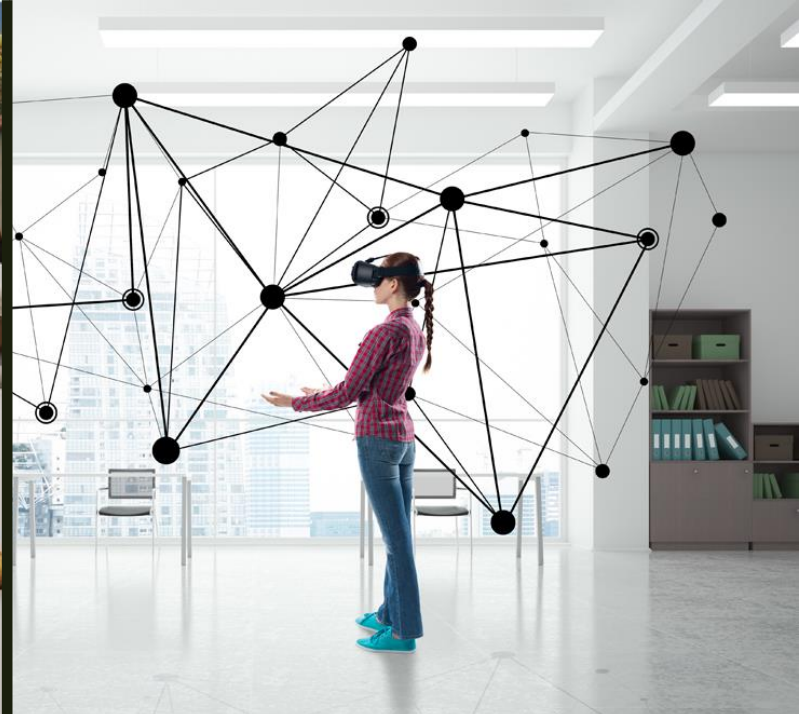


VR, MR, AR

- ▶ **VR** is a computer-simulated experience that replaces the user's perception completely from the real world to a similar or completely different virtual world.
 - ▶ It tricks the user's senses into thinking they are in a different environment, *the sense of presence*.
 - ▶ Using a head-mounted display (HMD) or headset, the user experiences a computer-generated world of imagery and sounds in which one can manipulate objects and move around using haptic controllers while tethered to a console or PC.
- ▶ **MR** combines real world and digital elements. Usually, the user wears a head-mounted display (MR).
 - ▶ MR allows the user to immerse in the combination of real and virtual world using their own hands.
 - ▶ It provides the ability to have one foot (or hand) in the real world, and the other in an imaginary place, breaking down basic concepts between real and imaginary.
- ▶ **AR** Augmented reality is where virtual objects and environments are mixed with the real world.
 - ▶ The user views his real environment along with computer-generated perceptual information.
 - ▶ AR overlays digital information on real-world elements. Augmented reality enhances the real world experience with other digital details, layering new layer of perception,



Examples



A Comparative Study of VR, MR & AR

Features	Virtual Reality	Mixed Reality	Augmented Reality
Display device	Mostly using Special headset or smart glasses	Headsets optional	Headsets optional
Image source	Computer graphics or real images produced by a computer	Combination of computer-generated images and real-life objects	Combination of computer-generated images and real-life objects
Environment	Fully digital	Both virtual and real-life objects are seamlessly blended	Both virtual and real-life objects are seamlessly blended
Presence	Feeling of being transported somewhere else with no sense of the real world	Feeling of still being in the real world, but with new elements and objects superimposed	Feeling of still being in the real world, but with new elements and objects superimposed
Awareness	Perfectly rendered virtual objects that cannot be distinguished from real objects	Perfectly rendered virtual objects that cannot be distinguished from real objects	Virtual objects can be identified based on their nature and behavior, such as floating text that follows a user
Interaction	Joysticks and controller	Finger touch and tap interaction	Either controllers or gestures
Perspective	Virtual objects will change their position and size according to the user's perspective in the virtual world	Virtual objects behave based on user's perspective in the real world	Virtual objects behave based on user's perspective in the real world
Usage	Extensively used in games, education and training	Moderately used in games and training	Scarce usage
Consumer Adoption	Low due to high cost and complex hardware requirements	High due to low cost and ease of downloading application on mobile phones	Low due to high cost and complex hardware requirements

Immersive Technologies & Cultural/Creative Industry: 3D Modeling (1)

3D Reconstruction of the City of Calw in Germany using images and photogrammetry methods

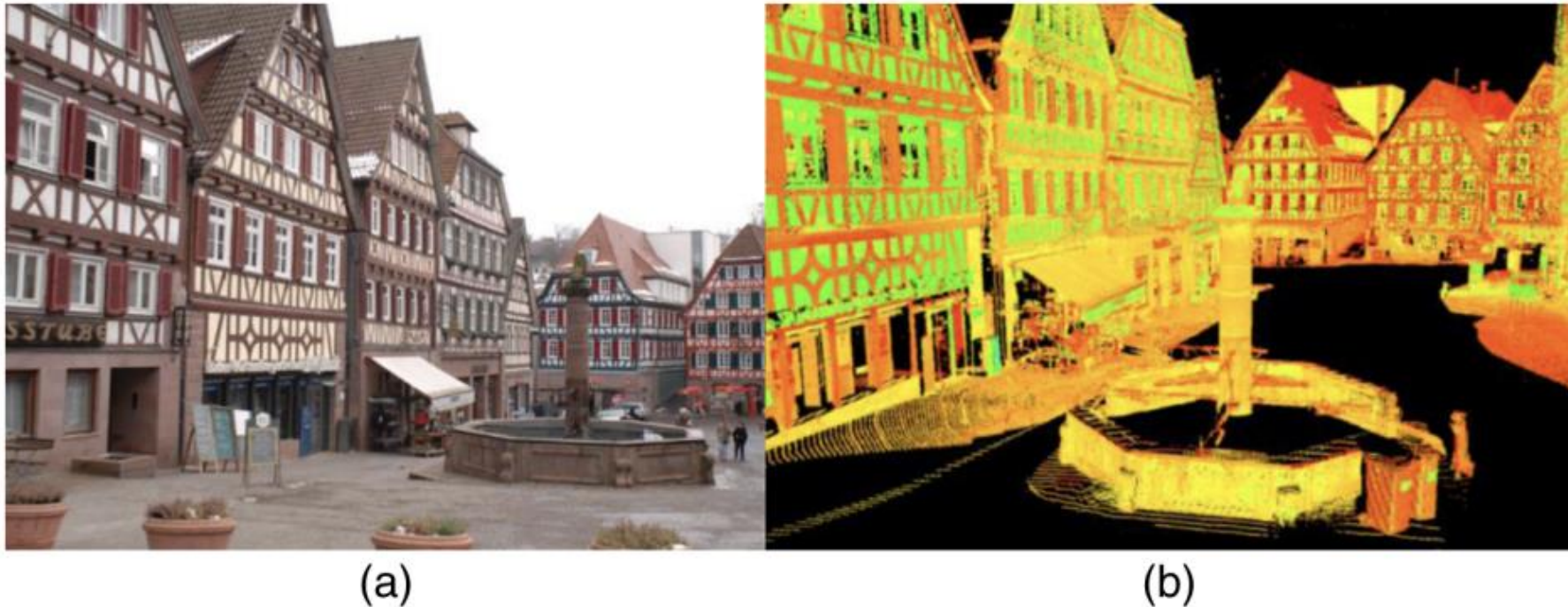


Fig. 7 (a) Calw market square, lower part and (b) point cloud.

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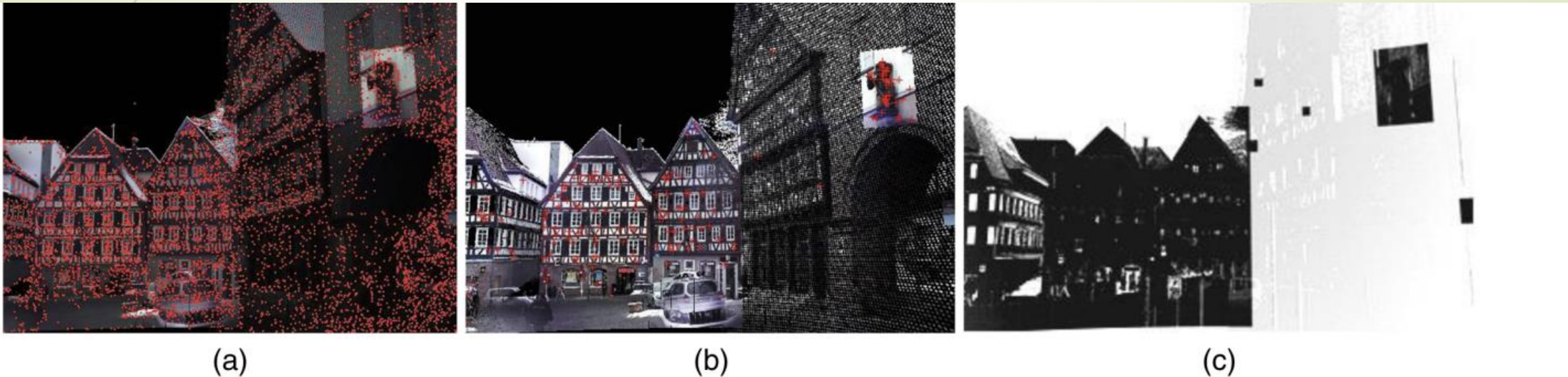


Fig. 11 (a) Detected features in VisualSFM via SIFT, (b) feature matches and filtering via SIFT descriptor and RANSAC with known 3-D object coordinates, and (c) intensity images showing white band gaps as less favorable.

Immersive Technologies & Cultural/Creative Industry: 3D Modeling (1)

3D Reconstruction of the City of Calw in Germany using images and photogrammetry methods



(a)



(b)

Fig. 14 ICP—selected points for first alignment. (a) Point clouds from Imagery and (b) TLS point clouds.



4D & 5D Modelling

The EDICULA Immersive Event: 19th December 2022, 10:30-14:30

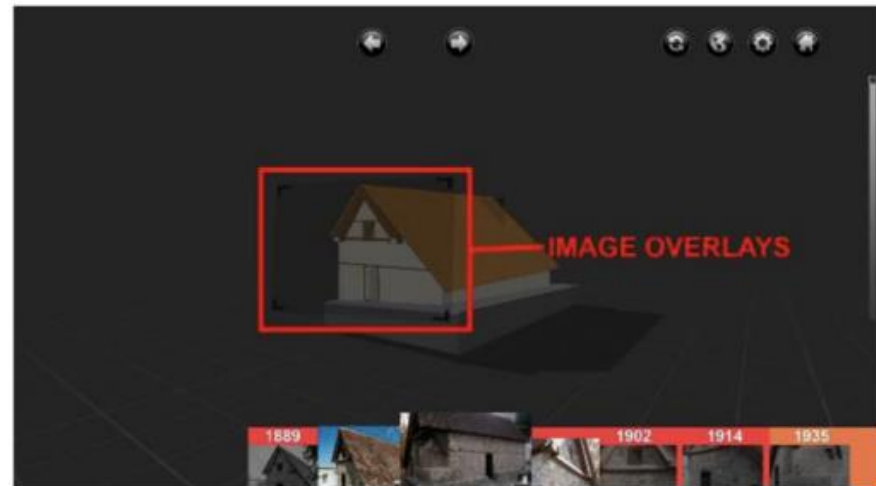
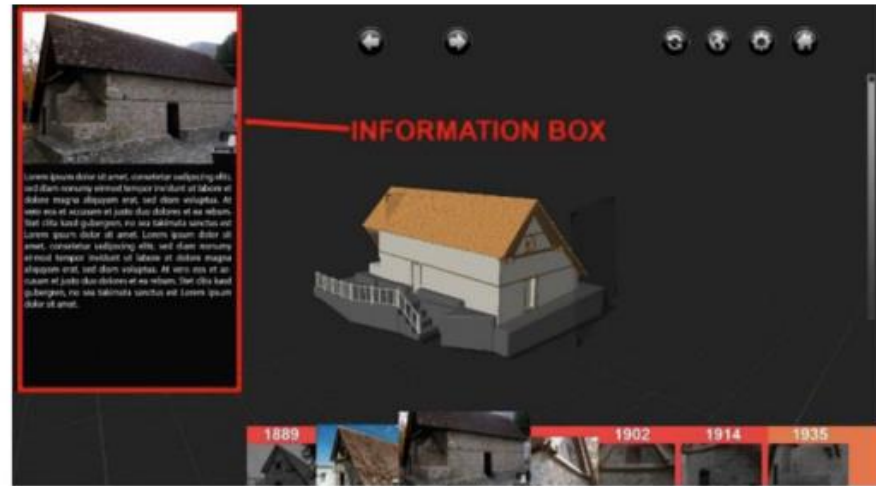
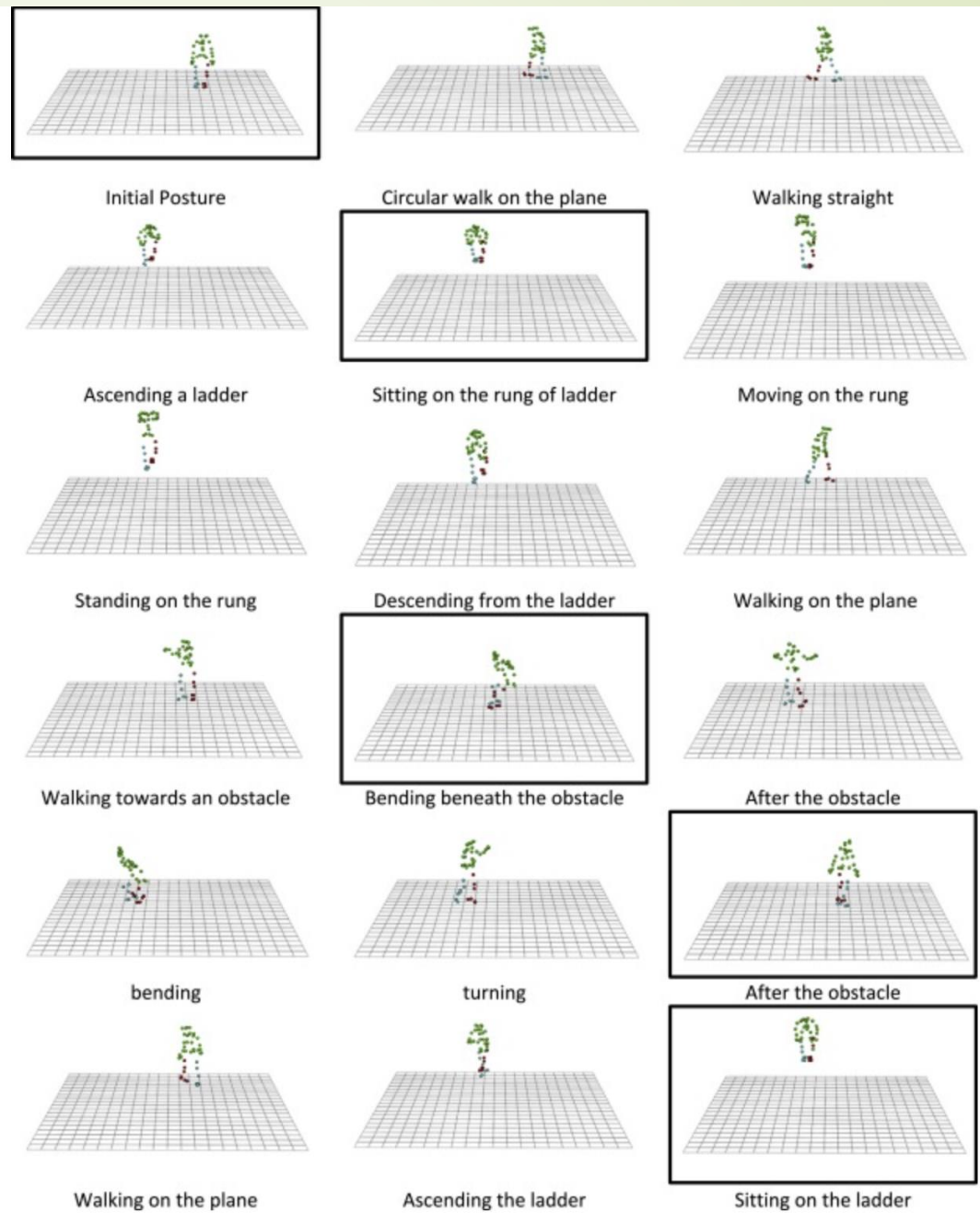


Fig. 27 CH-VR viewer features: (a) timeline, (b) information box, (c) slice tool, and (d) image overlay.⁵⁰

4D & 5D Modelling

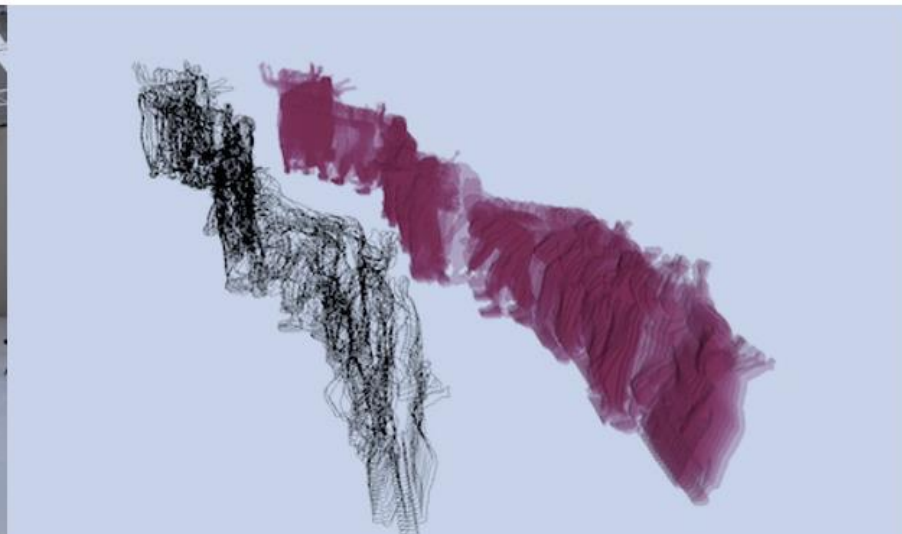
Intangible Cultural Content Modelling

Digitalization of Dances



Intangible Cultural Content Modelling

Digitalization of Dances





(a)



(b)



(c)



(d)

Fig. 5. Different 3D view of the collapsed St. Paul church as depicted by the visualization engine.

Impact of Natural Disasters of CH Buildings - Rescue Spaces

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(a)



(b)



(d)

Fig. 7. Visualization of hidden 3D survival spaces, assisting civil protection agencies to better manage an urban search and rescue procedure. (a) indicative examples. (b) zoom in images.

Impact of Natural Disasters of CH Buildings - Rescue Spaces

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The Holy Aedicula in my room

AR Technologies & The Holy Aedicula

- AR technologies for navigating over the Holy Aedicula of the Holy Sepulchre Church in Jerusalem
- We have used mesh decimation techniques to reduce the number of polygons, vertices and the edges so that the model can be reduced to 20mb without deteriorating its quality.
 - Necessary for loading the model onto mobile devices of low CPU and memory requirements
- The 3D model of the Holy Aedicula can be viewed by any field, and be displayed using conventional AR mobile devices with the use of Google ARCore via Android and ARKit via Apple iOS devices



CH End -Users

- ▶ **Cultural heritage stakeholders**
- ▶ **Cultural heritage professionals, experts, researchers**
 - ▶ Precise analysis on the 3D geometry plus the time
- ▶ **Constructors/restorers/conservators**
 - ▶ Precise restorations actions to respect the monument values
- ▶ **Sustainable preservation professionals**
 - ▶ Resilience to climate change, weather phenomena, natural disasters, human impacts
- ▶ **Educators**
 - ▶ To disseminate the knowledge to next generation
- ▶ **Creative/Cultural Industries**
 - ▶ Entrepreneurship, entertainment, serious games, business opportunities, employment
- ▶ **Single Users**
 - ▶ **General public, citizens, students, young,**
 - ▶ **Tourists**

