



VISMAC 2020
LA VISIONE DELLE MACCHINE - PALERMO

21 to 24 September, 2021

Extended reality and cultural heritage: a
bridge between preservation and the future

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Klain Robotics

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Fabcube



Who we are

Alessandro Dal Col

Expert in innovation projects management and new technologies application.



A company active in factory automation and in the distribution of robot and mechatronic components

Nicola Comand

Expert in photogrammetric processing and robotics.
Drone pilot



A technology company with experience in innovation and new tech development

Summary

- Extended reality is an exploding field that is rapidly spreading throughout the whole industry. The price drop of the wearable devices made this technology accessible to much more users and, within 2025, a 600 % increase in their sales is expected.



Market trends

- ER is rapidly entering our lives creating many business opportunities. VR and AR are being used by the industry to train workers, perform remote assistance and many other uses are being developed.



Application

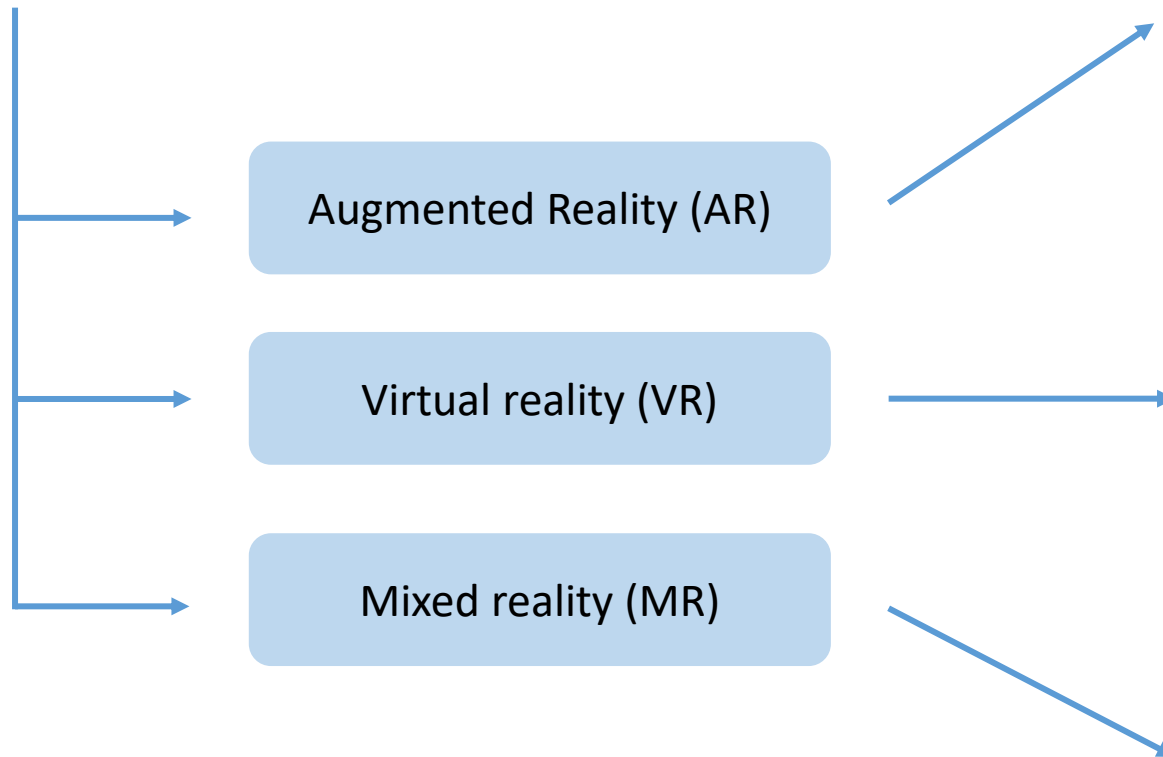
- They have proved to be particularly useful also to preserve the historical and cultural heritage through virtual reconstruction of both buildings and artifacts, allowing creation of immersive experiences and different ways to enjoy them.



The 3DLab project
we are partners in

Extended reality

Extended reality (XR)

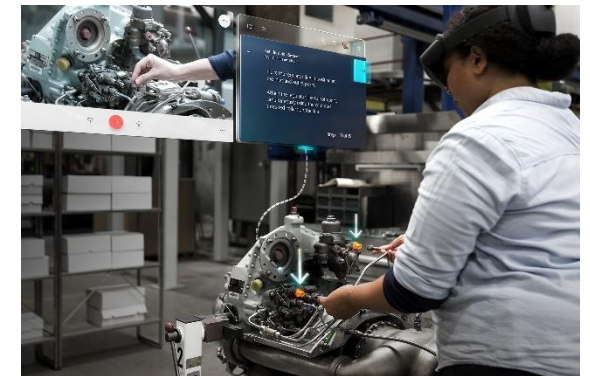


A popular AR mobile game



A VR application with an HTC headset

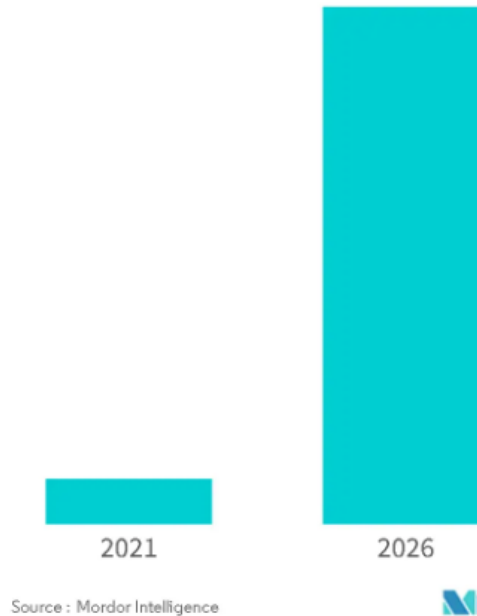
An industrial MR application with the Hololens



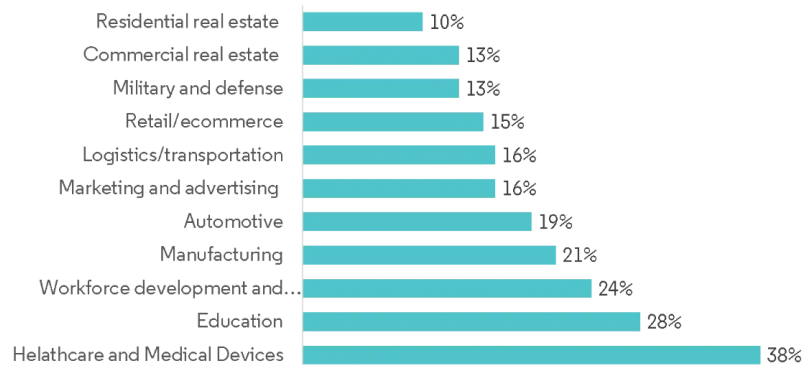
The market - XR

The Extended Reality (XR) Market is valued at USD 26.05 Billion in 2020 and is expected to reach USD 463.7 Billion in 2026, registering a healthy CAGR of over 62.67% during the forecast period (2021 - 2026).

Market Summary
CAGR 62.67%



Expected Sectors to be Most Disrupted by XR/AR/VR/MR Over Next 12 Months, in %, United States, 2020



Study Period: 2019- 2026

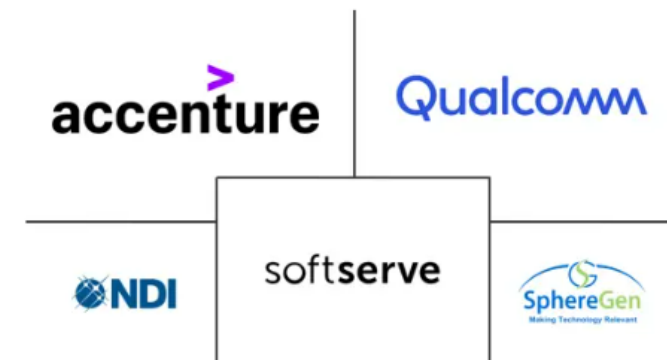
Base Year: 2020

Fastest Growing Market: Asia Pacific

Market:

Largest Market: North America

CAGR: 62.67 %



Source: Mordor intelligence, 2020

The market - VR

The **Virtual Reality (VR)** market was valued at USD 17.25 billion in 2020 and is expected to reach USD 184.66 billion by 2026. VR Technology has gained widespread recognition and adoption over the past few years. Recent technological advancements in this field have revealed new enterprises. Numerous players are emerging in this market with the hopes of navigating it toward mainstream adoption.



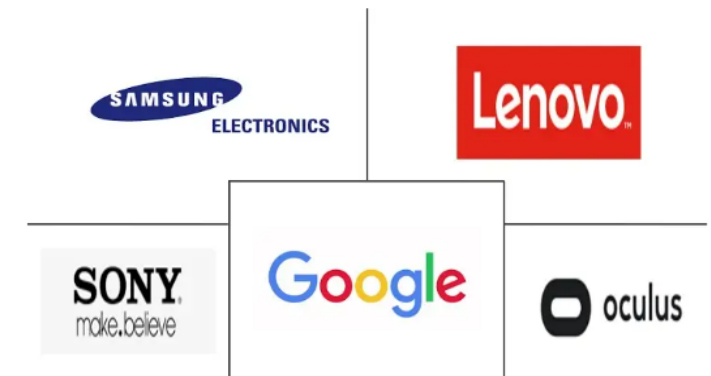
Study Period: 2018 - 2026

Base Year: 2020

Fastest Growing Market: Asia Pacific

Largest Market: North America

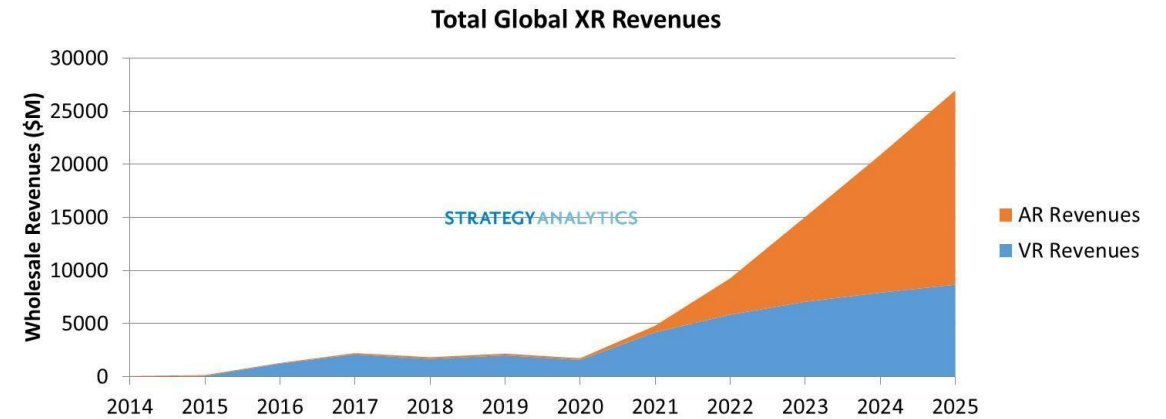
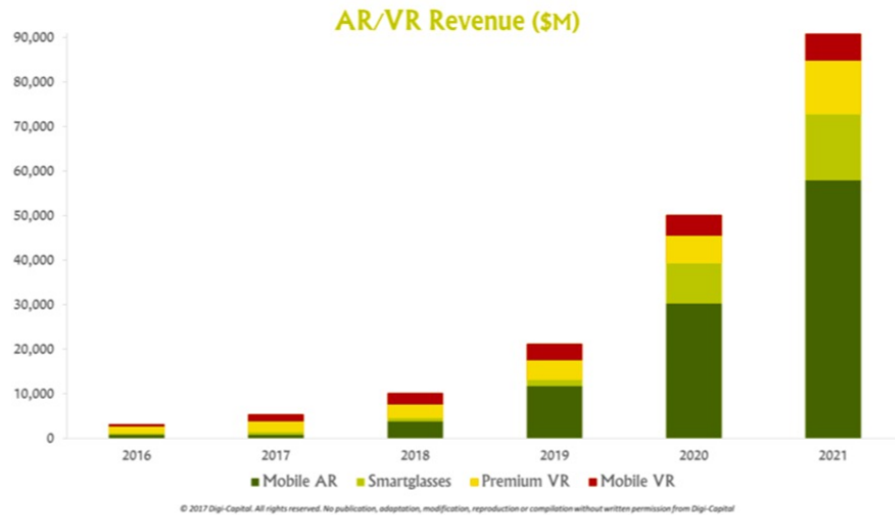
CAGR: 48.7 %



Source: Mordor intelligence, 2020

XR in figures

- A costantly rising trend (2025 > +600%)



- In 2020 AR and VR market value reached 29,5 billion dollars

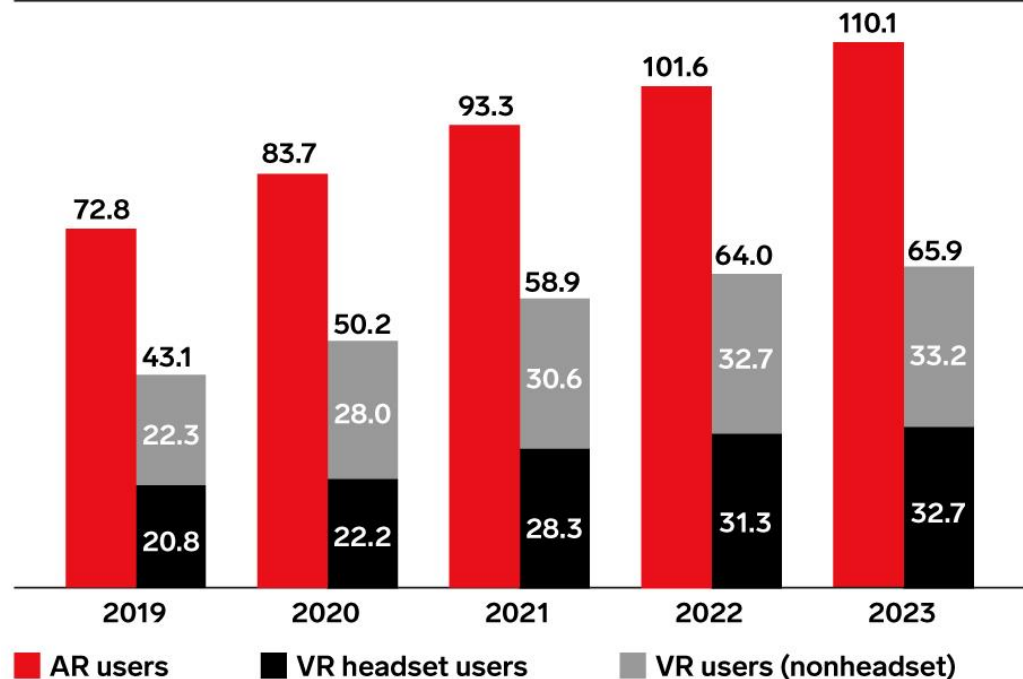
- **Within 2022 AR and VR devices** will reach a stable hi-tech market share, with sales forecast up to **39,2 million units** for VR devices and **26,7 million units** for AR

- The predictions show that Extended Reality will be able to generate 1500 billion dollars and more than 23 million job opportunities

XR in figures

US AR/VR Users, 2019-2023

millions



Note: individuals of any age who experience VR content at least once per month via any device; AR users are individuals of any age who experience AR content at least once per month via any device

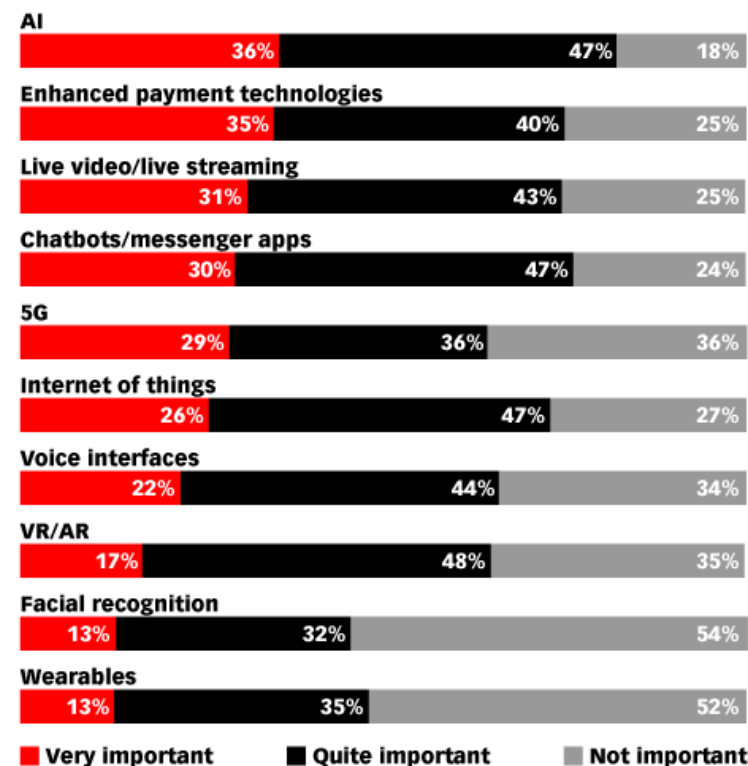
Source: eMarketer, March 2021

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eMarketer | InsiderIntelligence.com

Importance of Select Emerging Technologies in 2020 According to Client-Side Marketers and Agency Executives Worldwide

% of respondents



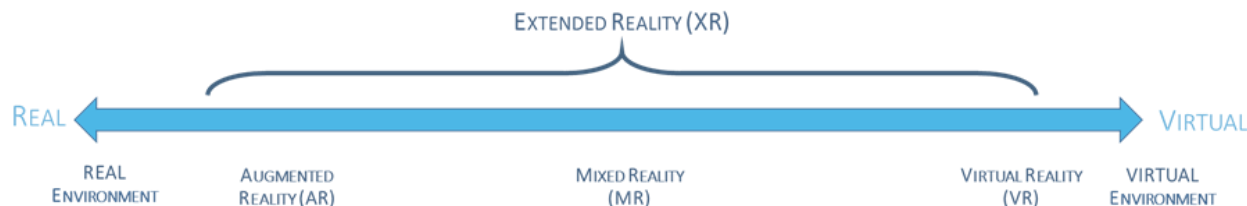
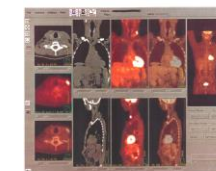
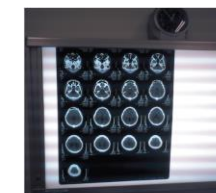
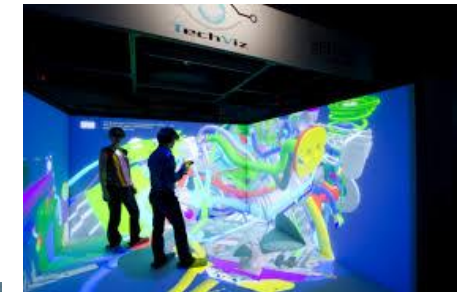
Note: numbers may not add up to 100% due to rounding
Source: Warc, "The Marketer's Toolkit 2020," Dec 2, 2019

251959

eMarketer | InsiderIntelligence.com

AR, VR and XR classification

	Augmented reality	Virtual reality	Mixed reality
Definition	Virtual objects enrich the real environment	Completely virtual environment	The combination of virtual and real environment creates a new reality
Relation between real and virtual world	The real world is at the center of perspective	The world is exclusively virtual and the real one is excluded	The virtual and real components are interconnected
Interaction between user and digital environment	Low or not present	Interaction exclusively with the virtual world	Equal to the interaction with the real world
Requirements	Smartphone, tablet or pc	VR headset	MR device

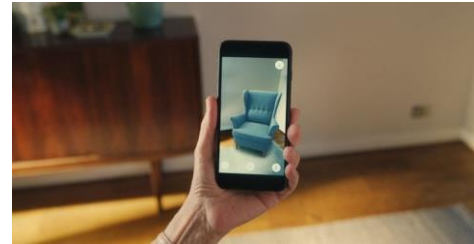


Technologies

ER type

Augmented
Reality (AR)

Device



Retail Price

400 €

Virtual reality
(VR)



Oculus Quest 2
350 €

Mixed reality
(MR)



Microsoft HoloLens
3500 ÷ 5200 €

AR Example

The town of Sabbioneta (Lombardy), within the regional project #InLombardia, recreated the history of the local theater in augmented reality and in virtual reality.



DIGITAL THEATRE:
500 ANNI IN UN'APP

http://www.comune.sabbioneta.mn.it/servizi/eventi/cerca_fase03.aspx?ID=2504

VR gamification example

The virtual side of Venice was a project developed for an exhibition that was cancelled because of the pandemic. The experience allows the user to enter the traditional building site for the the local boat, the «Gondola» and actually build one of them.



https://www.youtube.com/watch?v=sv3YiDef5_M

MR example

In this example a company built an hologram of Michelangelo's «Pietà» that you can interact with.



<https://www.youtube.com/watch?v=bVmyjGUMnCE>

Experiential marketing

- Create **engagement** between the public and the places
- Try before choosing
- **Immersive** digital narrative experience



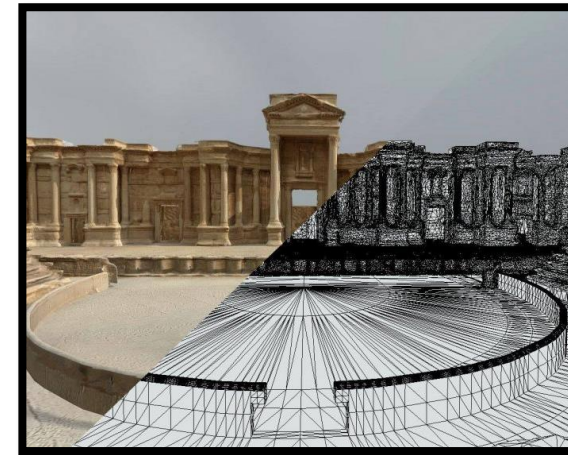
Capture attention through **sensorial experiences**;

Stimulate **moods** and **feelings**;

Create stimula inviting to take **action**.

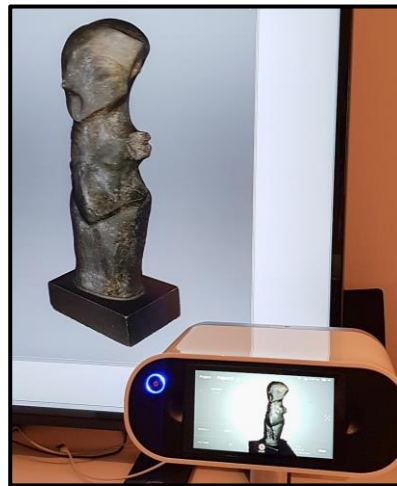
Use of VR in cultural dissemination to:

- Convey more captivating contents
- Insert new elements into the offer
- Recreate experiences able to produce intense memories



Some examples?

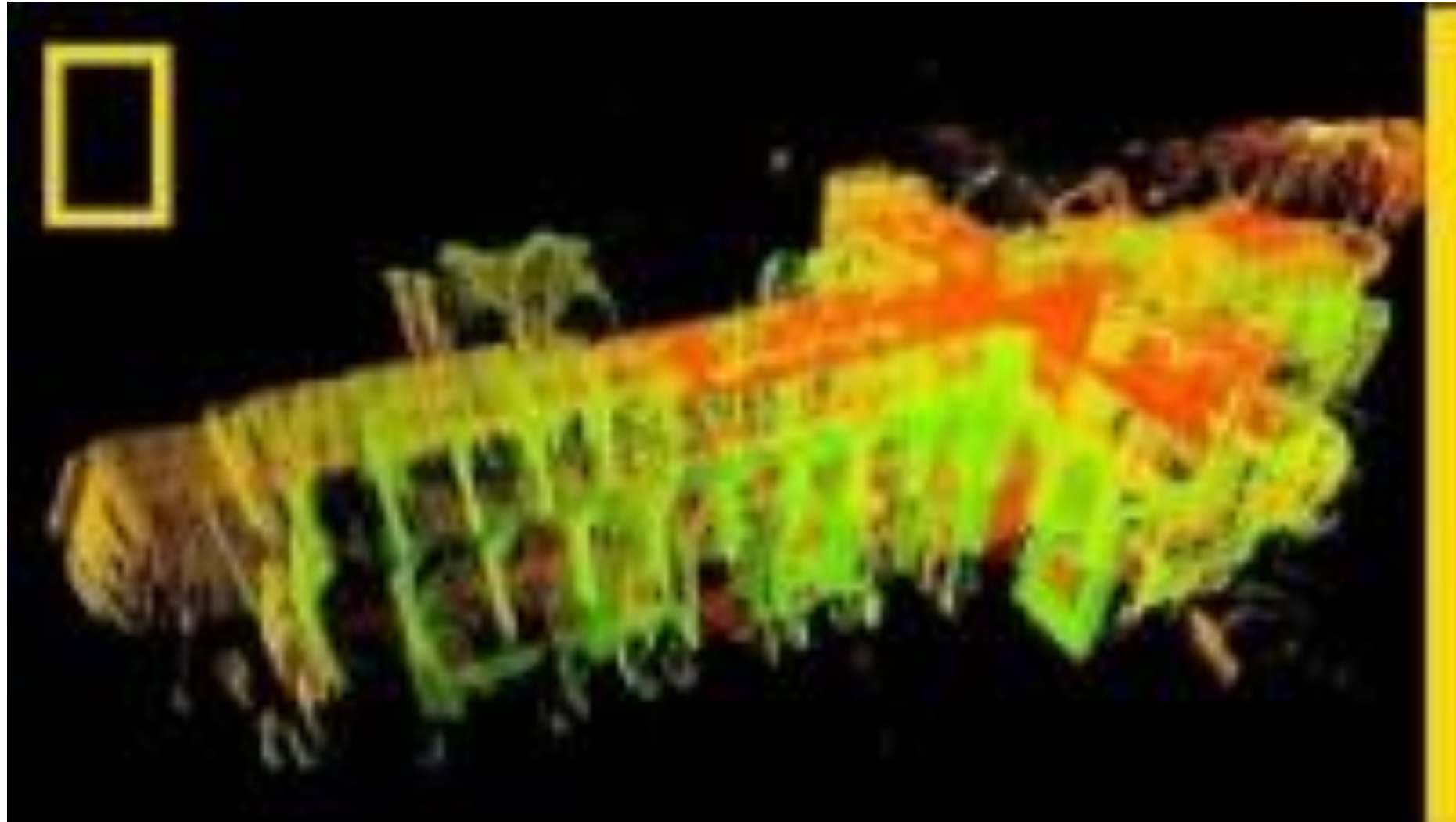
Cultural heritage preservation



The virtualization of the cultural heritage can help in case of high damage due to political events or natural disasters. Two examples are the site of Palmira and the Notre Dame Cathedral. The first, located in Syria, was heavily damaged by the Isis soldiers, but some virtual reconstruction is available and allows to visit some of the buildings. The second, located in Paris and heavily damaged by a fire, can count on many virtual reconstructions, from videogames to cultural projects.

Cultural heritage virtualization

Art historian Andrew Tallon reconstructs historical landmarks, unveiling their secrets, by means of a laser scanner



<https://www.youtube.com/watch?v=jAi29udFMKw&t=1s>

First Person Experience

VR visit of S. Peter church in Cavallermaggiore (CN). The church was reconstructed with photogrammetry. In this case the VR guides users in the discovery of a not accessible historical site.



<https://vimeo.com/211493379>

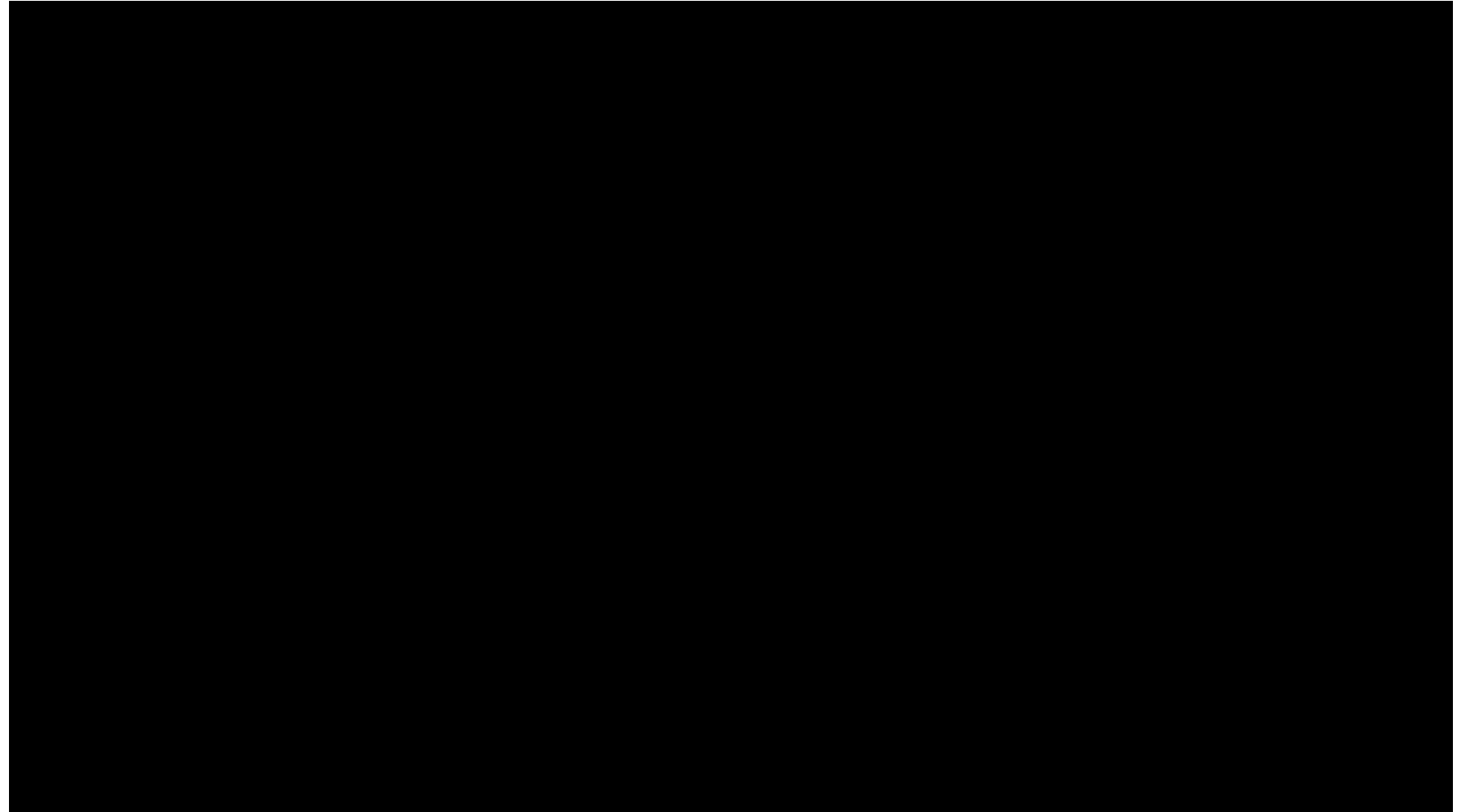
Outstanding realism

This video demonstrates a reconstruction of the Basilica del Sagrado Corazon de Jesus, Gijon. The experience is meant for an HTC VIVE device.

https://www.youtube.com/watch?v=zBCowvs2g_I

Gamification

This is an example of the digitally reconstructed Monastero della Stella Saluzzo (VR), but there's something more. The experience steals some elements from the gaming world, giving birth to an experience of **gamification**, where some playful elements are brought into other contexts, in this case cultural heritage.



<https://vimeo.com/444182737>

3D objects

The virtualization involves also objects, not only environment. In our case, this will lead to a virtual library of contents that will be inserted into the AR or VR app to enrich the experience.



Cherub's statue



Archeological site, Civic Museum of Rovereto



Dante's statue, Piazza dei Signori, Verona

What perspectives



- Hardware price decreasing = bigger markets
- The discovery seen as an incentive to the visit

- State of the art today, what about tomorrow?
- User as the main character of a tale

... and the user has a great story to tell.



MailOnline

Science & Tech

Mark Zuckerberg wants to turn Facebook into a 'metaverse' - a virtual world where users can meet up and hang out - all from the comfort of the sofa

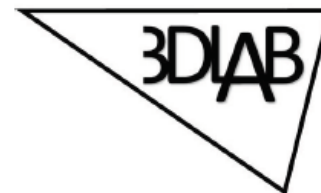
In a new interview on Thursday, Mark Zuckerberg said that over the next five years, he wants people to think of Facebook not as a social media company, but a 'metaverse' company, akin to a virtual environment where people can work and play for most of their 24 hours without leaving their home.

'And my hope, if we do this well, I think over the next five years or so, in this next chapter of our company, I think we will effectively transition from people seeing us as primarily being a social media company to being a metaverse company,'

Daily Mail, 22 July 2021



The 3D Lab-Sicilia project



Progetto 3Dlab-Sicilia

"Creazione di una rete regionale per
l'erogazione di servizi innovativi basati su
tecnologie avanzate di visualizzazione"

N.08CT4669990220 - CUP: G69J18001100007

Obiettivo Tematico 1 – Ricerca, Sviluppo Tecnologico e Innovazione
Obiettivo specifico 1.1 - Incremento dell'attività di innovazione
delle imprese

Azione 1.1.5 - Sostegno all'avanzamento tecnologico delle imprese
attraverso il finanziamento di linee pilota e azioni di validazione precoce
dei prodotti e di dimostrazione su larga scala

Ambito: Smart Cities e Communities | Sub Ambito: Smart Economy

Importo progetto: €3.996.985,59
Importo agevolazione: €3.567.561,18

Partners

(5 companies + 5 research groups)



Università
degli Studi
di Palermo

PARCO SCIENTIFICO E TECNOLOGICO
DELLA SICILIA



UNIVERSITÀ
degli STUDI
di CATANIA



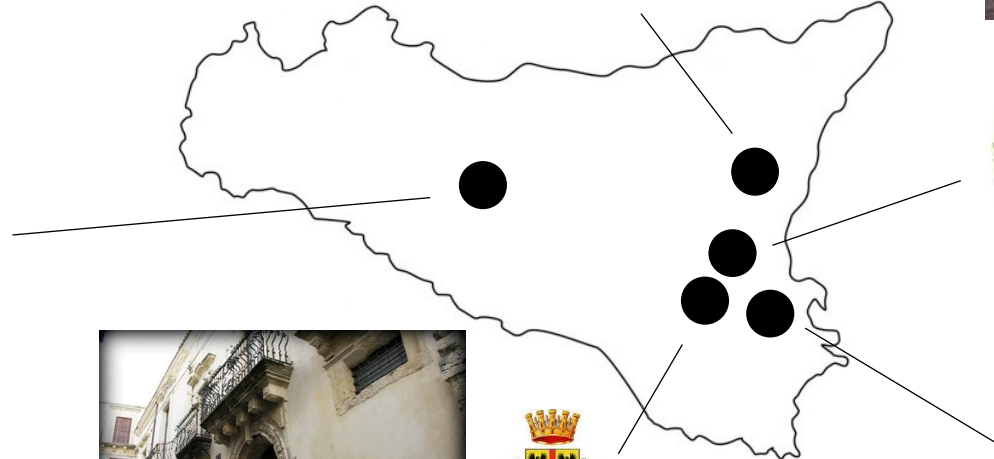
Behaviour
Labs

www.blabs.eu



- Create, develop, validate and promote a regional infrastructure made of 3 locations dedicated to a virtual and augmented reality
- Validate the infrastructure equipment and the pipelines with many user cases according to a regional strategy aimed at innovation whose application will be ready for the market
- Create a «liquid lab» to promote the fast development of AR/VR applications

Locations involved



Militello



Mussomeli



Vizzini



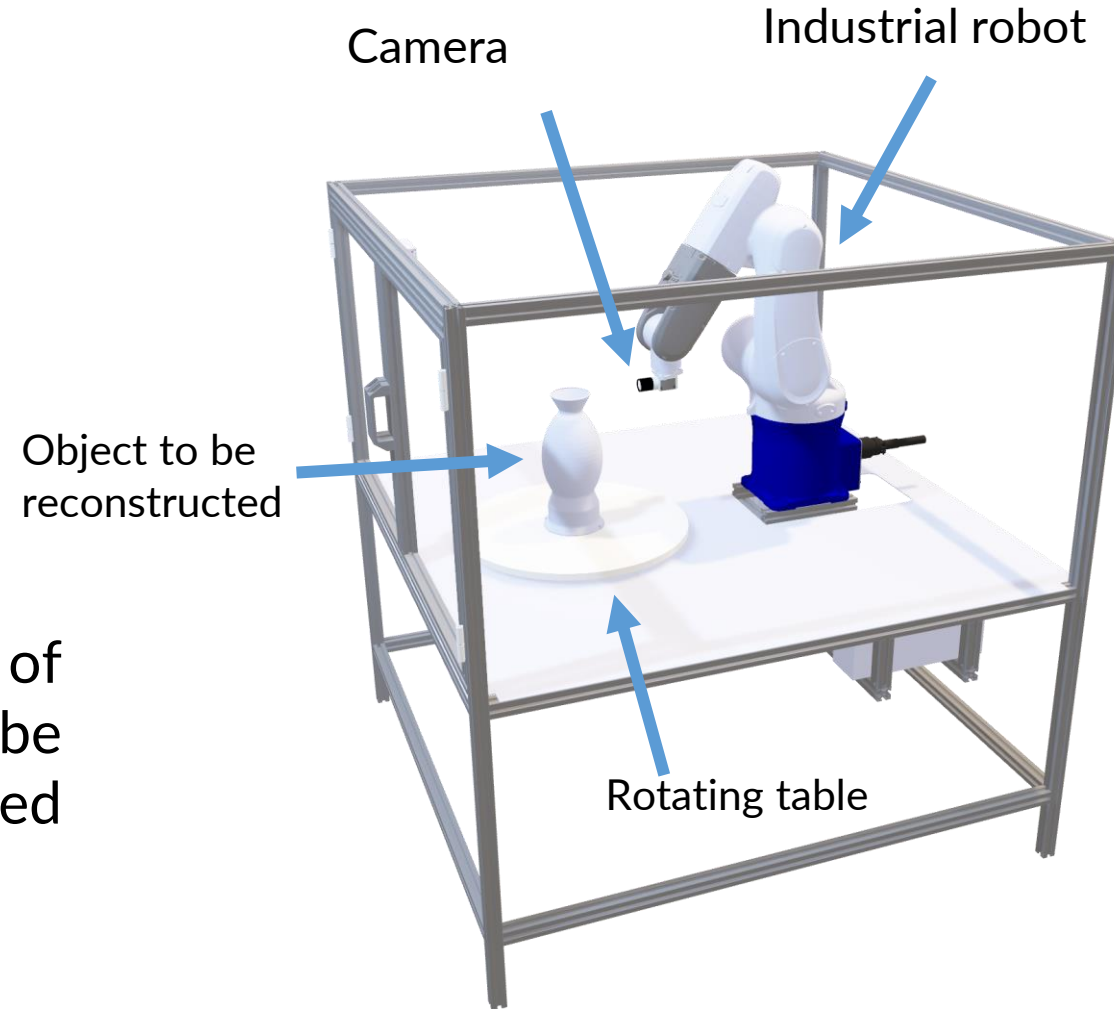
Sortino



Robotic cell for virtualization

- Automatic
- Optimal conditions
- Easy of use

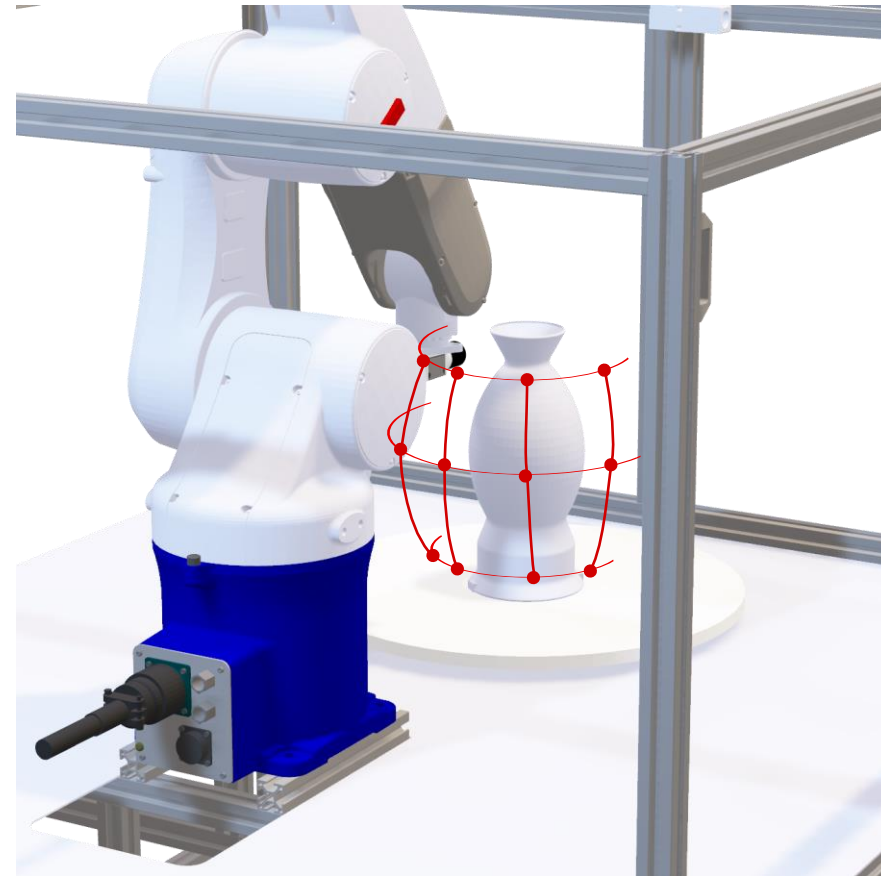
Creation of a virtual library of 3D objects that will be visualized online or inserted into the 3D experiences



Robotic cell for virtualization

- Automatic
- Optimal conditions
- Easy of use

Creation of a virtual library of 3D objects that will be visualized online or inserted into 3D experiences



Aerial photogrammetry

- From a photographic set to a 3D object
- Pictures taken from a UAV (Unmanned Aerial Vehicle)
- Natural or architectural landscapes reconstruction



<https://www.youtube.com/watch?v=D0kJLEAgjQo>

Aerial photogrammetry

Some examples of historical sites reconstructed with aerial photogrammetry.

<https://www.youtube.com/watch?v=78PZBHxiTk>



Chiesa di San Giovanni Battista



Castello di Rocca Calascio



Torre Marchionale Estense



<https://www.youtube.com/watch?v=rMynY670EHI>

<https://www.youtube.com/watch?v=EHydJjOLfql>

Aerial photogrammetry

- UAV are used
- 20 to 60 minutes flying time
- Payload up to 10 kg



Autel Evo 2



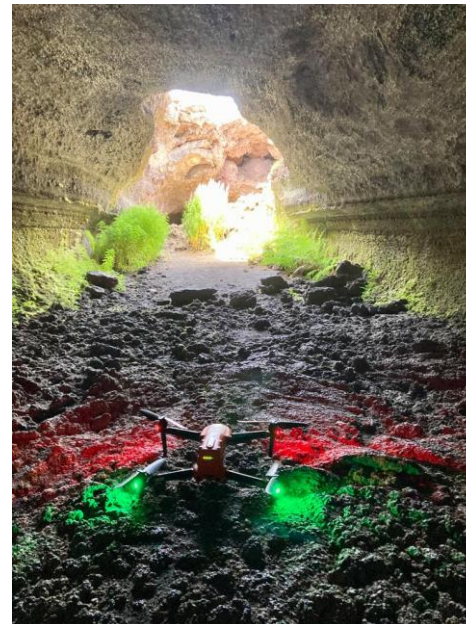
The difference between their cases



DJI Mavic 2

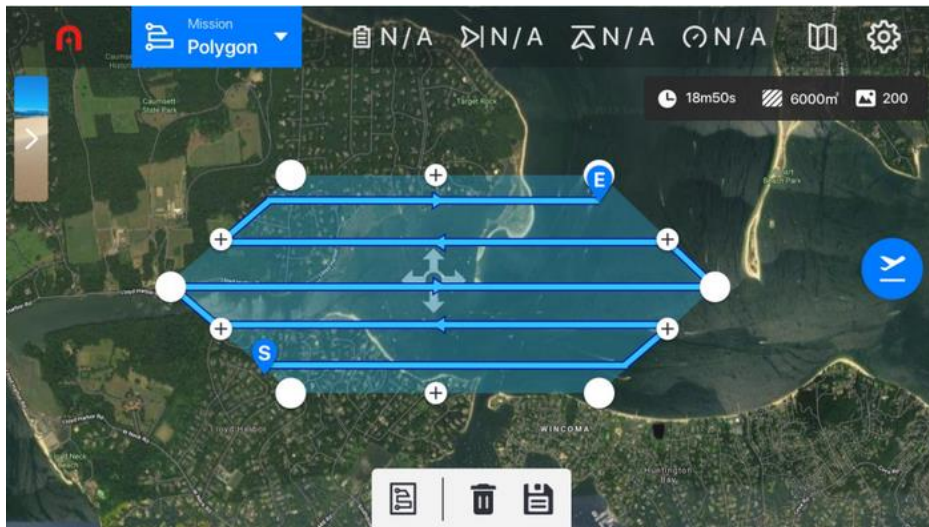
Our UAV

- Autel Evo Pro 2
- 1200g take off mass
- 6K camera
- Flying time up to 30' with one battery

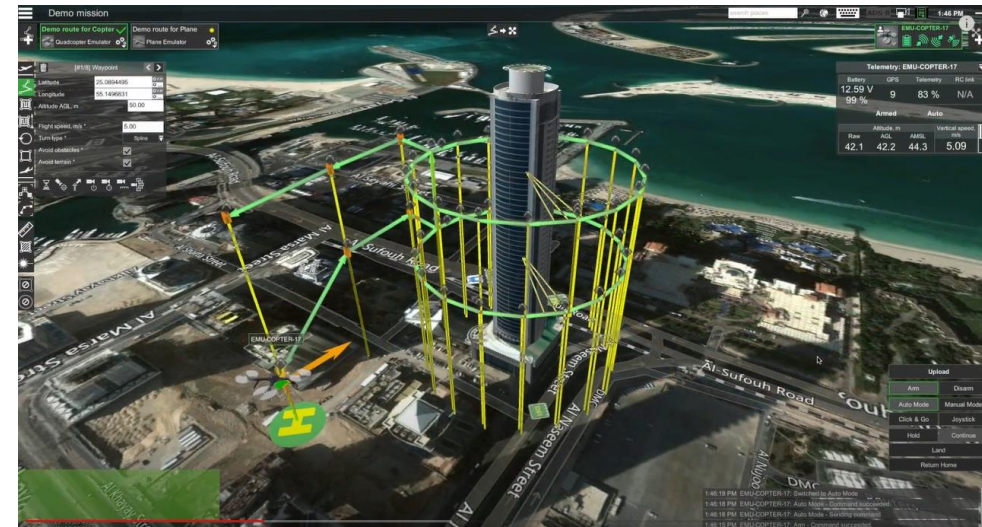


Mission planning

- Mission creation with appropriate programs
- GPS location tracking
- Different types of mission, e.g. oblique, waypoint, orbit, etc.



Autel interface



Microgeo UgCS

Mussomeli castle

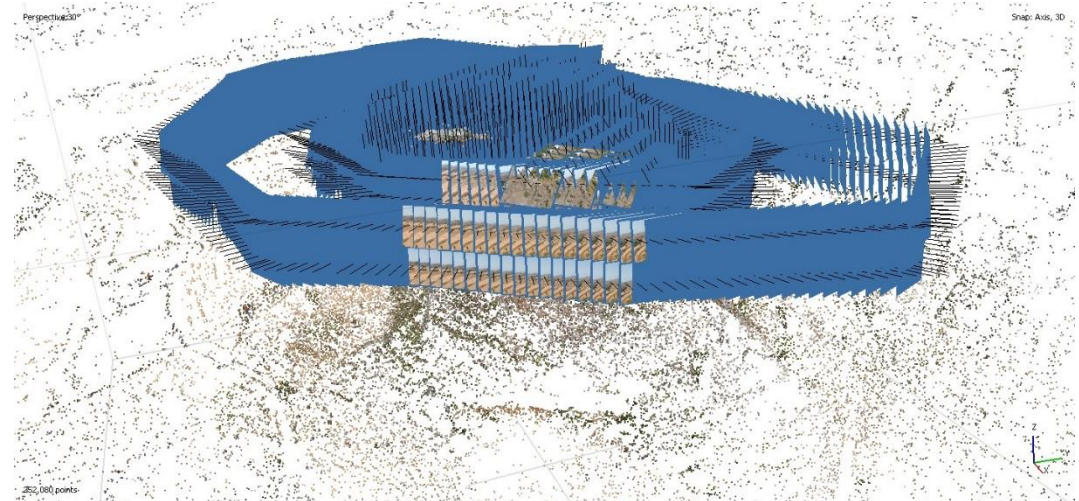


The castle can be traced back to the 13th century and it is located on a rocky hill, close to the town of Mussomeli.

Mussomeli castle



A snapshot of the photogrammetric mission made with the UAV



An intermediate state of elaboration



The final 3D model



The workflow:

- The photogrammetric survey
- Elaboration with photogrammetry softwares
- Creation of the 3D models
- Use of the 3D models through other softwares

Mussomeli castle



The 3D model of the castle imported into Unity allowing a virtual tour of the site

3D Lab Examples

Rifugio della Galvarina – Parco dell'Etna

A picture of the building



A walkthrough of the 3D model imported into Unity



The 3D model



3D Lab Examples

The natural reserve of Pantalica –
Sortino (SR)

An aerial recording of
the site
➔



An animation of the
model
➔



The 3D model
➔

3D Lab Examples

The Borbonic prison – Vizzini (CT)

A picture of the site



Perspective 30°



An animation of the
3D model



Faces: 32,519,370 vertices: 16,287,672

3D Lab Examples

The town library – Sortino (SR)



← An aerial image of the town library

Sometimes the survey has to be integrated with ground photogrammetry because of obstacles or narrow spaces and the photogrammetry software has to be aided with some markers, well visible points that can be manually identified in the pictures.

The Verga museum – Vizzini (CT)



An ground image of the museum →



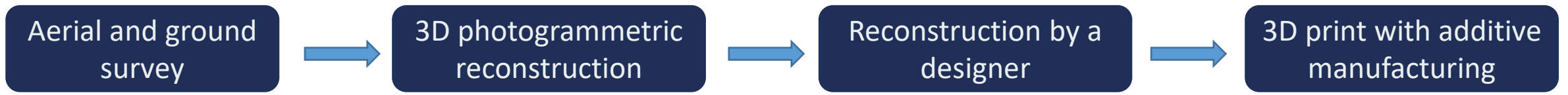
← An intermediate step of elaboration

The 3D model with some markers →



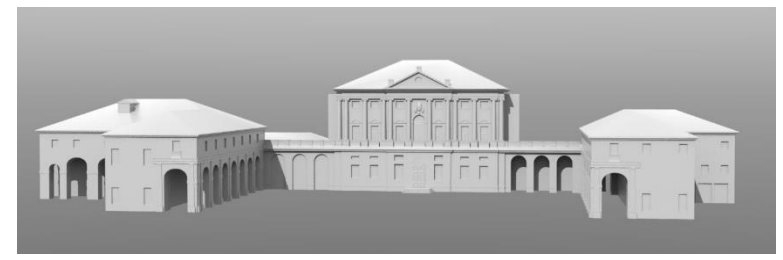
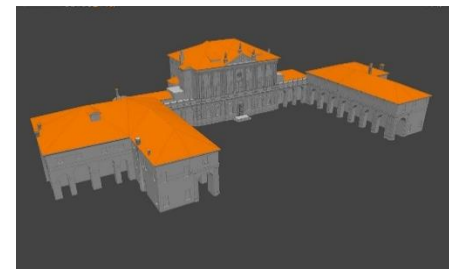
Venetian Villas

We are working on a regional project that aims to create little 3D printed models of some of the most beautiful venetian villas in order for blind people to appreciate their beauty



- UAV (drone)
- Reflex camera

Some snapshots of the model reconstructed by the designer



Villa Ca' Marcello
– Stra (VE)

The printed 3D model of the villa



Venetian Villas

Villa Wieldmann – Mira (VE)

→
A picture of the villa



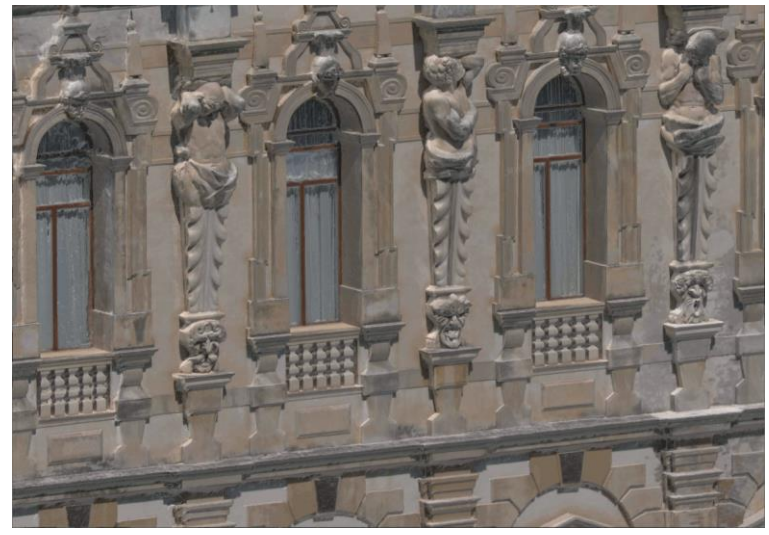
← →
The 3D model



Venetian Villas



A picture of the villa



A 3D reconstruction of a villa detail



Villa Contarini - Piazzola sul Brenta (PD)

The photogrammetric model of the villa



The little chapel of the villa



Conclusion

Starting from the ER world and devices, through many application examples, to some user cases personally implemented, the value of Extended Reality in cultural heritage applications has been showed. Recalling the presentation:

- The value of preserving and promoting cultural heritage has been presented and several user cases have been shown.
- The exploding field of ER is becoming cheaper and more powerful, allowing a wider range of users to approach these kinds of experiences.
- The photogrammetry and autonomous aircrafts are paving the way for a cheaper and easier survey of the historical and cultural sites.
- The virtual models can be used for many purposes, first of all to promote tourism and produce visibility for many historical sites.

Thank you for your attention