How I learned to stop worrying and love the WEB3D

3DHOP FOR FUN AND PROFIT

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VISUAL COMPUTING LAB

**ISTI-CNR PISA, ITALY**

Who am I?

Marco Callieri

- Master degree & PhD in computer science

- Researcher at the Visual Computing Lab, ISTI-CNR, in Pisa
- I work on 3D data manipulation and rendering... lot of experience in 3D scanning and data processing
- Most of my activities are in the field of cultural heritage

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Beside this:

an eclectic artisan, an avid gamer, a former biker, a good cook, an incorrigible geek... and much more
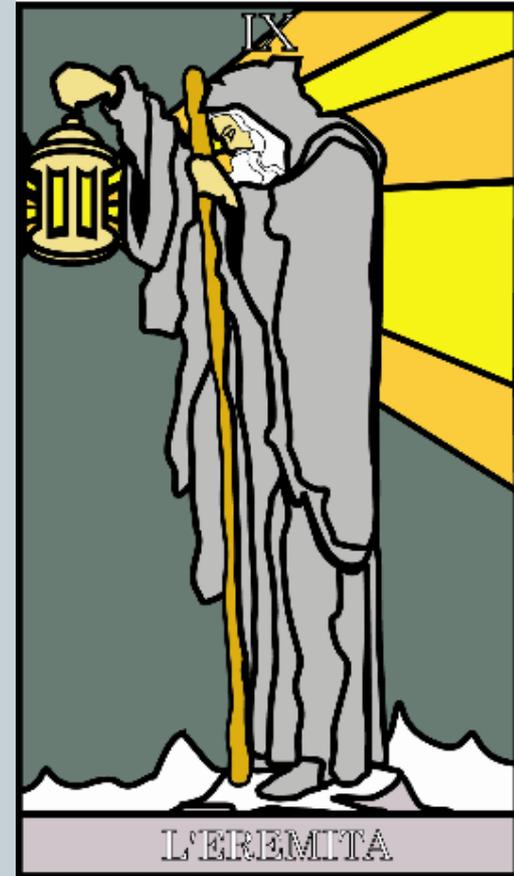
Who am I?

Marco Potenziani

- Master degree in engineering & PhD in computer science

- Researcher at the Visual Computing Lab, ISTI-CNR, in Pisa

- 3D scanning and processing
- CH applications
- 3D data visualization on web

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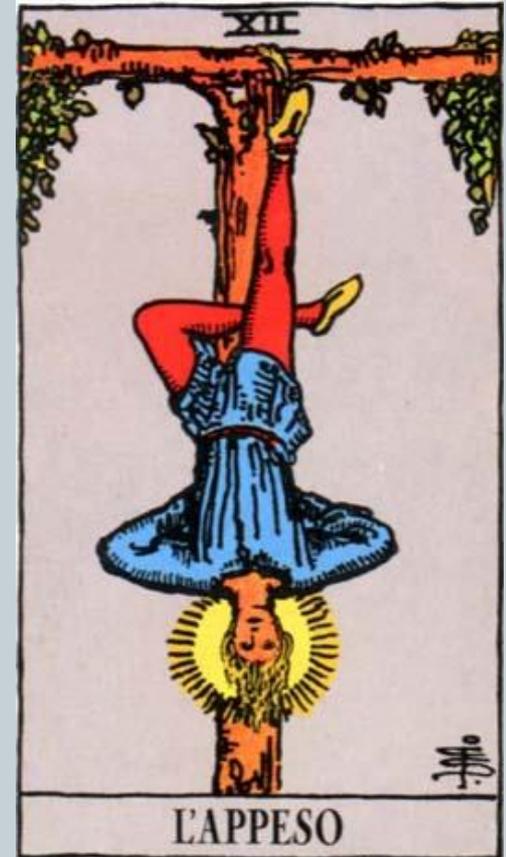
Visual Computing Lab

Research group working on **3D computer graphics**

part of:

Istitute of Science and Technologies of Information (**ISTI**)

part of:

Italian National Research Council (**CNR**)

http://vcg.isti.cnr.it
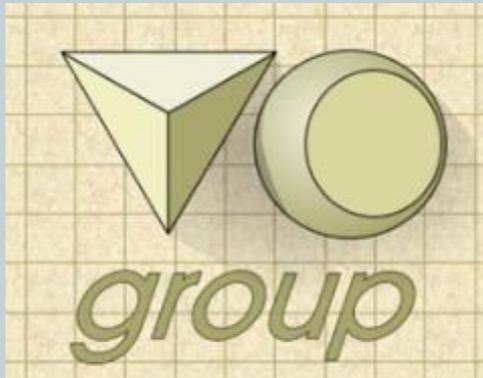
# Visual Computing Lab

Cultural Heritage
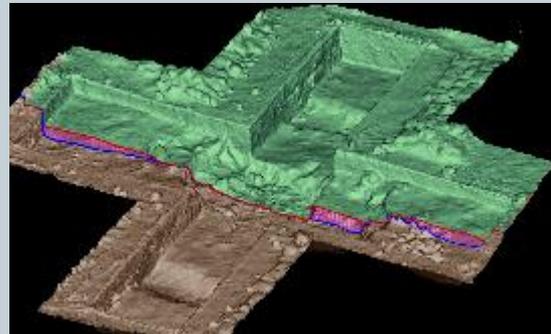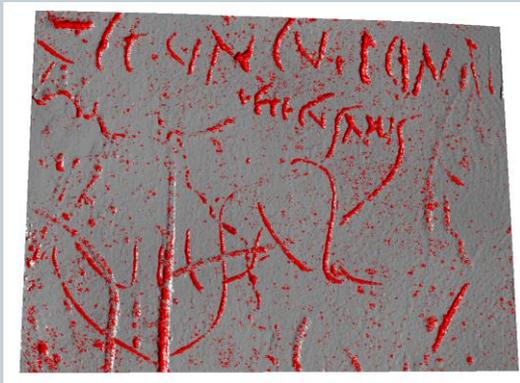
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Realtime
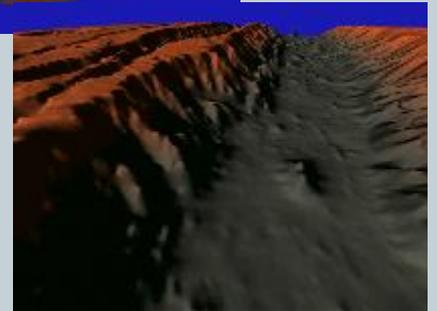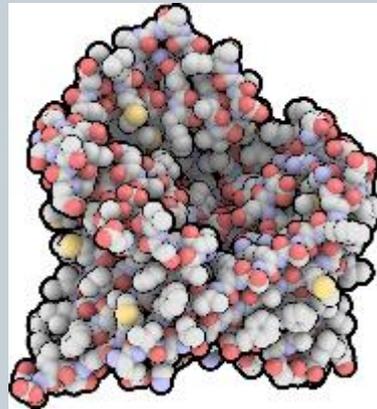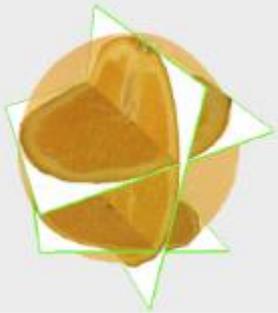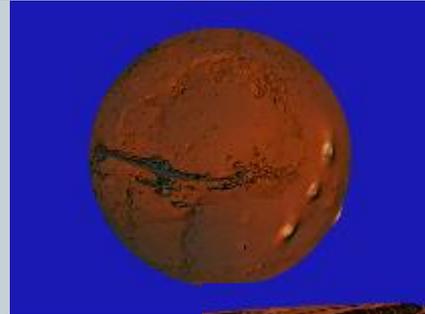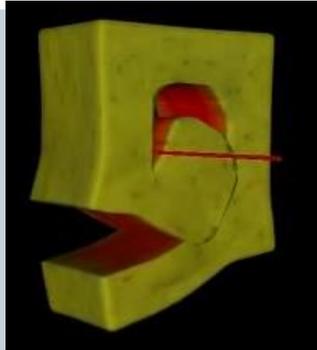
3D
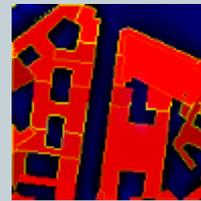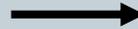
Texture encoding

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Geometry Processing
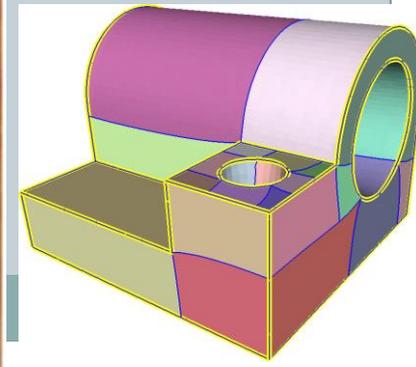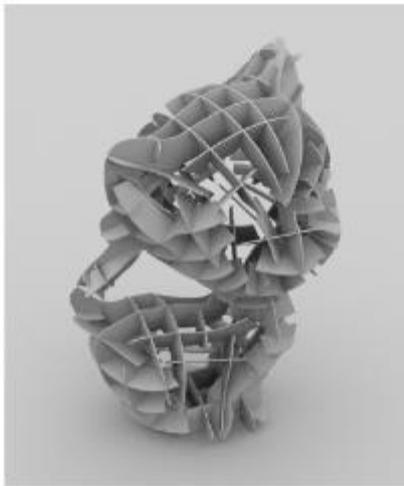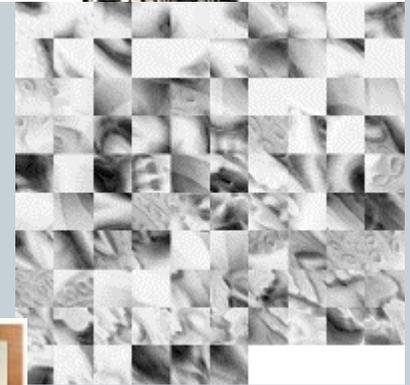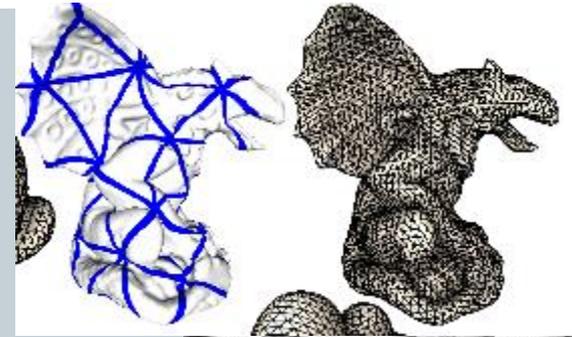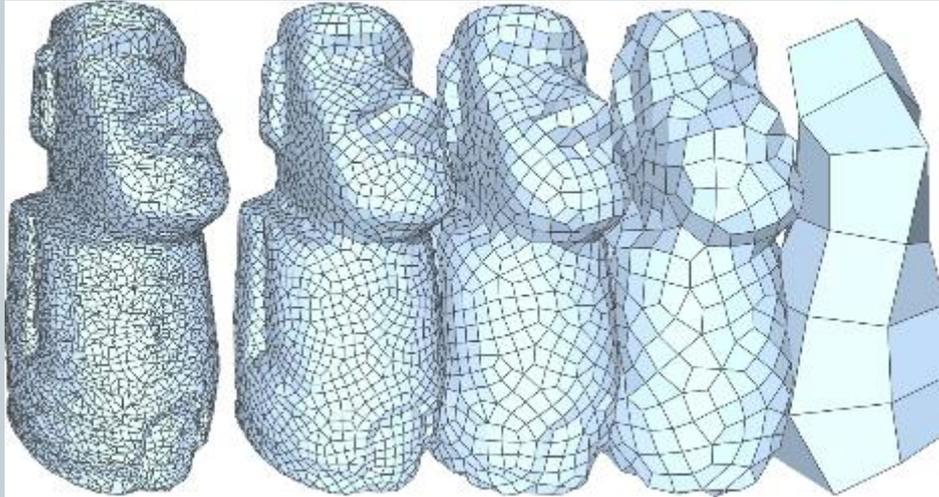
Our Lab

We work in different practical projects (especially in CH), but we are computer scientists... So, beside methodologies, we work on software tools...

Beside custom tools for one-shot o internal use, we maintain set of tools for the community:

- **VCG Lib:** open source C++ library for 3D data structures management

- **MeshLab:** open source tool for 3D mesh processing, editing and visualization

- **3DHOP:** open source tool for 3D visualization on the web

Dark ages

3D on web

When the web was born, 3D was not considered as a viable media.

Text, images, sound, even videos, but not 3D

- Too early
- Too much data (non sequential)
- Too much complexity in handling it

3D was managed using plug-ins…

Plug-ins are evil

- Instability and performance issue
- Incompatibility and difficulty of supporting multiple combination of OS and browsers
- People do not like to install third-party software, and actually some plug-ins were malicious

Every company/research lab had its own plugin and format.

One after another they failed.

VRML

The iconic son of its time.

The age when we all believed the future of interfaces and digital was Virtual Reality.

Declarative creation of entities, plus behaviour associated to entities. It was somehow possible to connect the page events to the viewer events.

Remains today as a file format, plus other derivative tools/pradigms
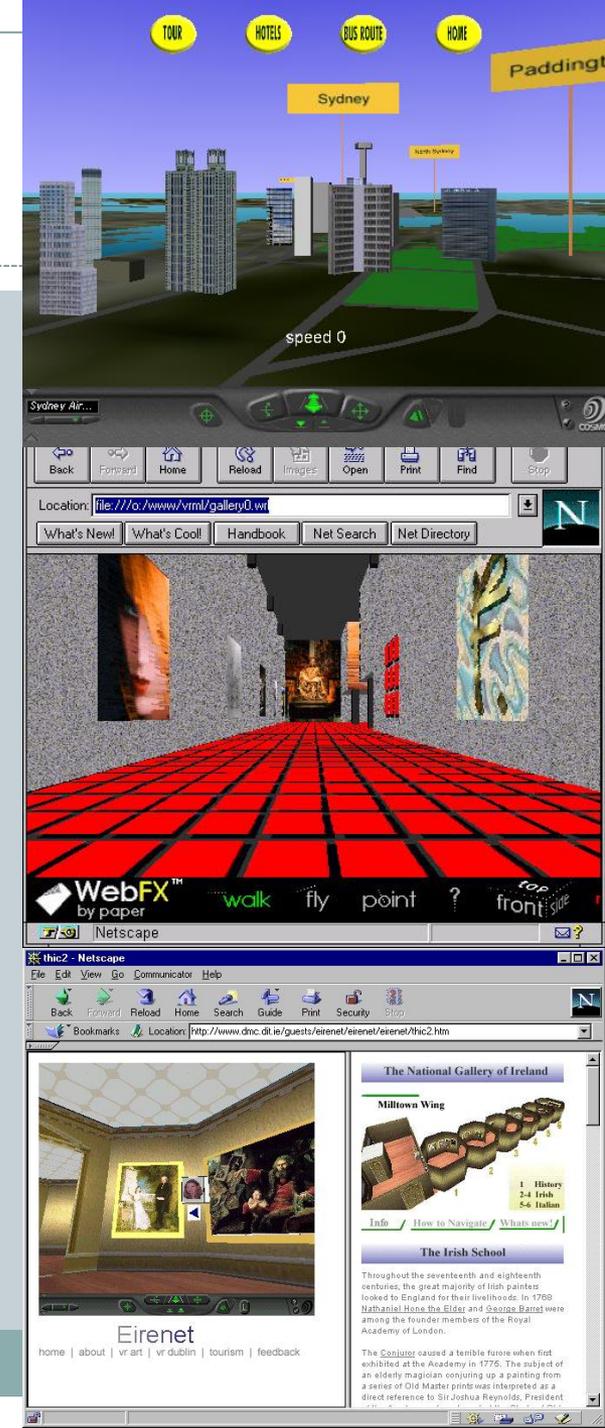
A new age of enlightement

WebGL

HTML5 came with a surprise: a way to display 3D data natively on the web.

WebGL is part of the HTML5 standard defining the JavaScript binding of OpenGL inside the browsers.

- Works natively inside the browsers
- Consistent across different browsers and OS (almost ☺)
- Has direct access to your graphics card
- Based on OpenGL ES2 (the standard for mobile devices)

WebGL

WebGL took the web by storm.

The presence of native 3D on web sprouted a sudden flooding of web apps working with 3D, open, free, freemium, and commercials.

Problem: WebGL is too low level to be used directly

Web3D apps are like onions...

They have *layers*.

This is pretty common in software development, where the application is built by stacking a series of libraries / components with growing levels of abstractions.

This stratification makes difficult to classify and approach this world, and multiplied the number of actors, solutions and assets.

Content

App

High-level library

Middleware Library

WebGL

Hardware
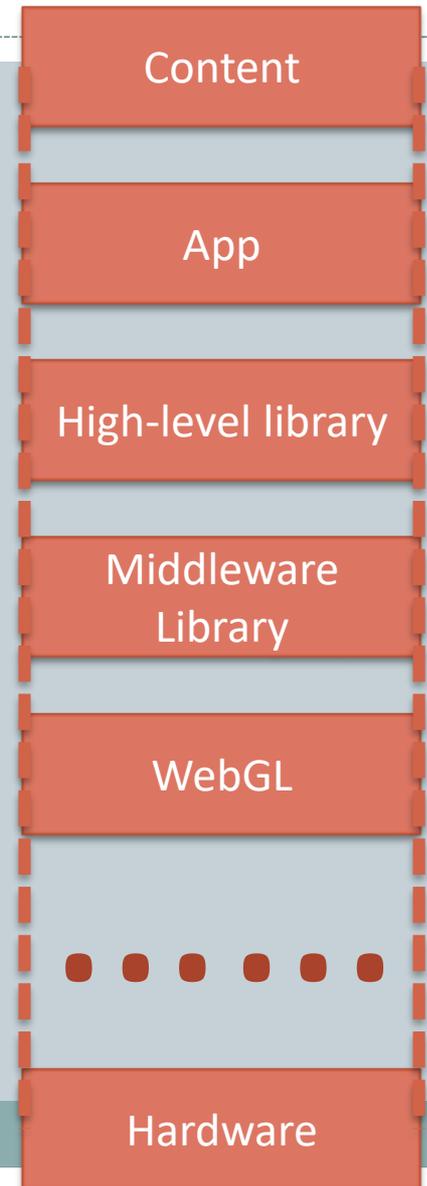
Web3D world

A recent survey / state of the art:

Publishing and Consuming 3D Content on the Web, A Survey

M. Potenziani, M. Callieri, M. Dellepiane, R. Scopigno

Foundations and Trends in Computer Graphics and Vision, Volume 10 (4) – 2018

Preprint:

http://vcg.isti.cnr.it/Publications/2018/PCDS18/

X3DOM

Developer library

This is the heir of VRML.

More focused on HTML developers, 3D entities are part of the DOM. Strong accent on the declarative approach

https://www.x3dom.org

Three.js

Developer library

More approachable for "classic" computer graphics developers.

Entities and methods closer to what is available in game engines and CG libraries.

https://threejs.org/
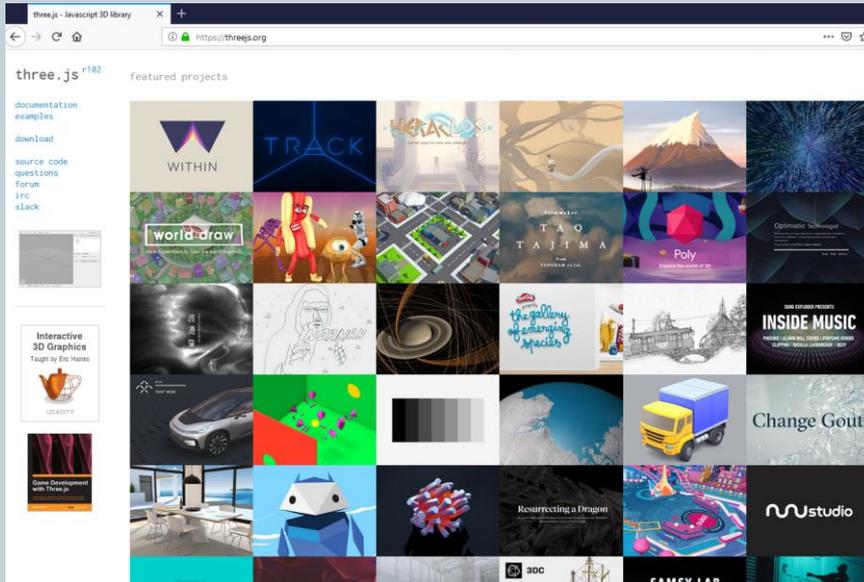
A-FRAME

Developer library

Oriented to WebVR applications. Many ready-made components, abstracting the basic elements of VR apps.

Built on top of Three.js

https://aframe.io
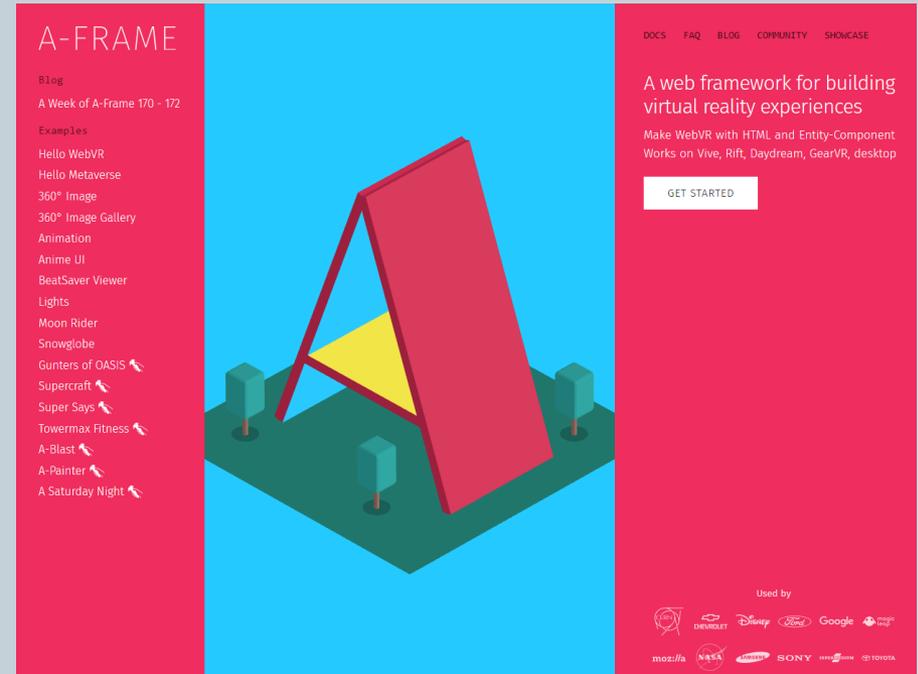
Going Up

Sketchfab

It's YouTube for 3D models...

Really, this cover almost all that we need to say.

Freemium service with remote storage. Simple, super portable viewer.

Recently, started to be also a selling platform.

https://www.sketchfab.com

Potree

About

Potree is a free open-source WebGL based point cloud renderer for large point clouds, developed at the Institute of Computer Graphics and Algorithms, TU Wien.

Examples

Third Party

https://potree.org/
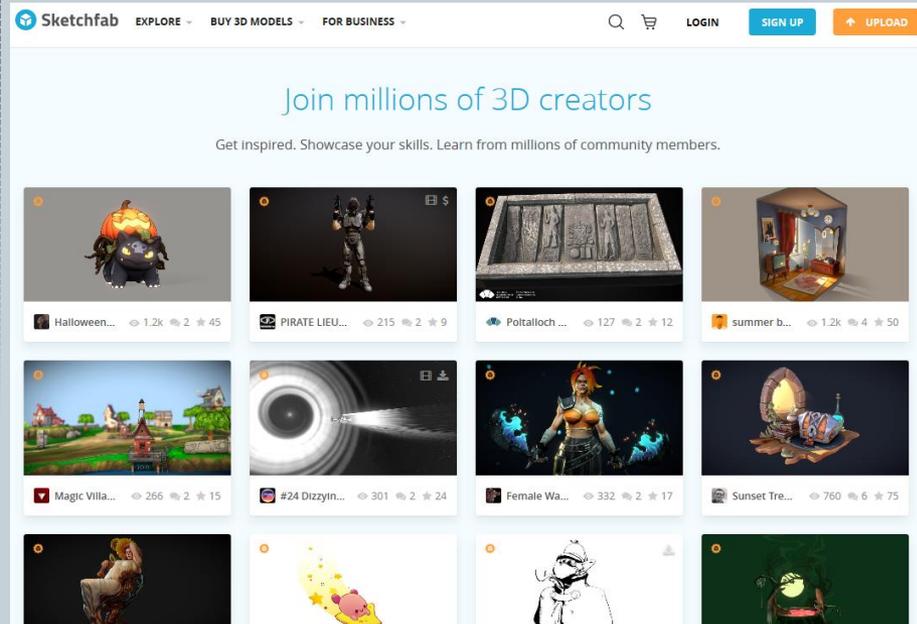
High-performances point-cloud web visualization.

Opensource, developed by a university. Able to work with huge datasets (multiresolution streaming). Viewer with advanced functionalities.

Download & deploy on your server
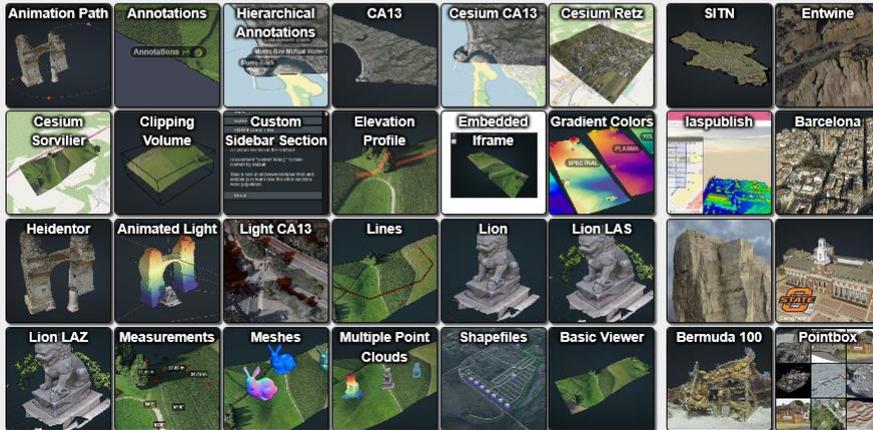
Smithsonian X3D

Smithsonian collaboration with Autodesk

At the moment, only available to the Smithsonian. Nice and fast rendering. The interface is a bit overwelming for non-experts

The guided tour is a must-see feature

https://3d.si.edu/

Not really on the same level, but

UNITY 3D

A full-fledged Game Engine, with a easy-to-use approach: drag assets, models and components to build simple interactive environments.

Among the many platforms, it is possible to export to web

Used A LOT in the CH world (it's free and portable), especially for reconstructions and immersive enviroments.

3DHOP

3DHOP

A tool for the web-based interactive presentation of high-resolution 3D models.

More precisely: a JavaScript framework with a set of configurable components.

- Based on HTML5 and WebGL, written in JavaScript
- Works in all modern browsers without plugins
- Designed to be easy to use and easy to learn
- Can deal with huge 3D models (10→100 Mtri)

Multiresolution

- The focus of 3DHOP is on managing high-res geometries, like the ones produced by 3D scanning or dense stereo matching…

- Triangulated meshes of 1 → 100 million triangles

- Model is preprocessed into a format which is streaming-friendly, and that can be efficiently rendered using a viewpoint-optimized mesh.
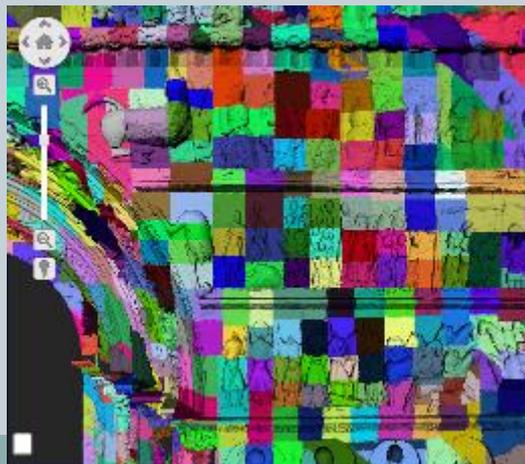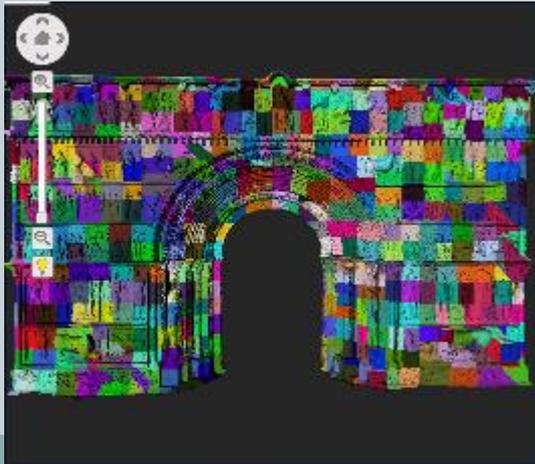
3DHOP

- Strong integration with the webpage
- Simple interaction with 3D data
- Fully customizable and extensible
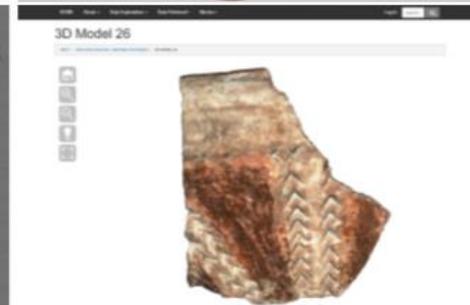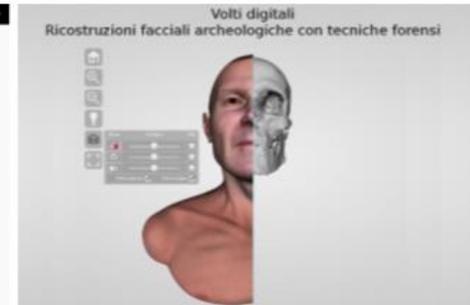
What is 3DHOP ?

3DHOP has been designed to cope with the usual needs of the CH field: simple interaction, view animation, hotspots, visibility. The tool has a very simple configuration for the basic cases, but can also be heavily modified for specific situations.

3DHOP is open source, and is an active ongoing project, with regular updates and enhancements.

As it happened before with MeshLab, *3DHOP* is a software tool **WE USE FOR REAL** in our CH projects, that has been cleaned/polished in order to be usable also by others.

Aims and limits

3DHOP is NOT a silver bullet… It is a very focused tool

- SIMPLE scenes made of COMPLEX objects, not COMPLEX scenes made of SIMPLE objects
- Works with "polygon soup" models, but not much with structured, CAD-like models
- Designed for FAST development and deployment, limits on the complexity of visualization schemes
- SIMPLE and IMMEDIATE interaction, impossible to make games
- Easy to use, but still requires HTML editing and JavaScript programming

Easy stuff

Lots of customization work

Out of Reach
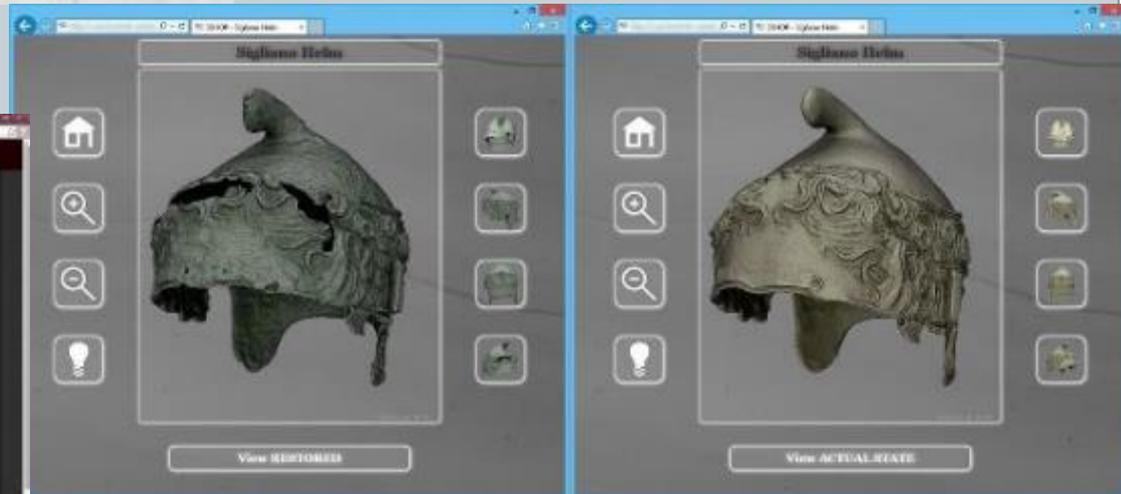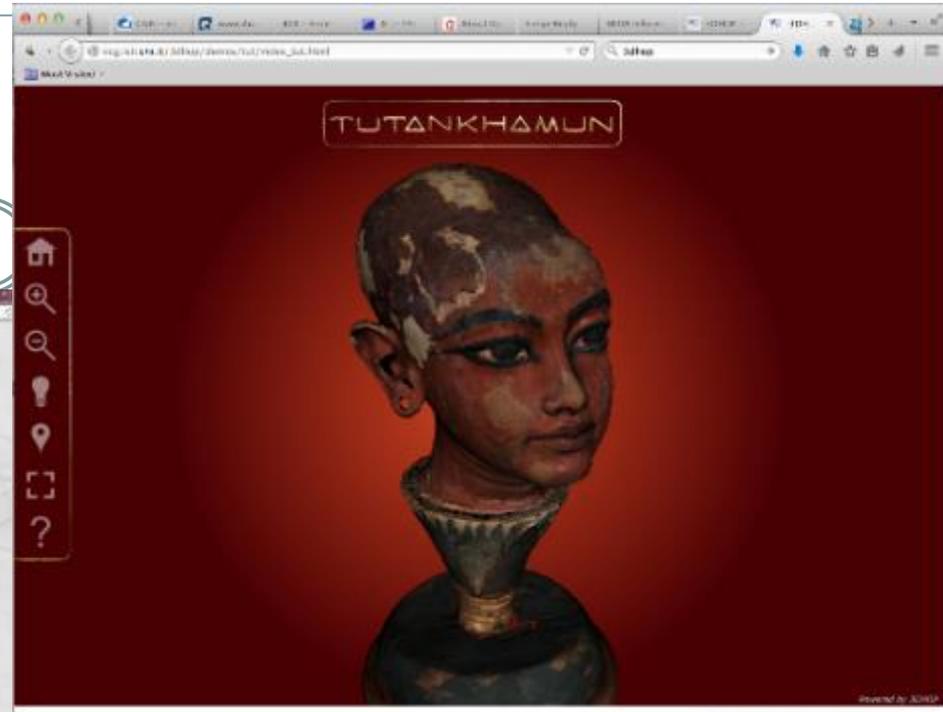
However, coding additional components
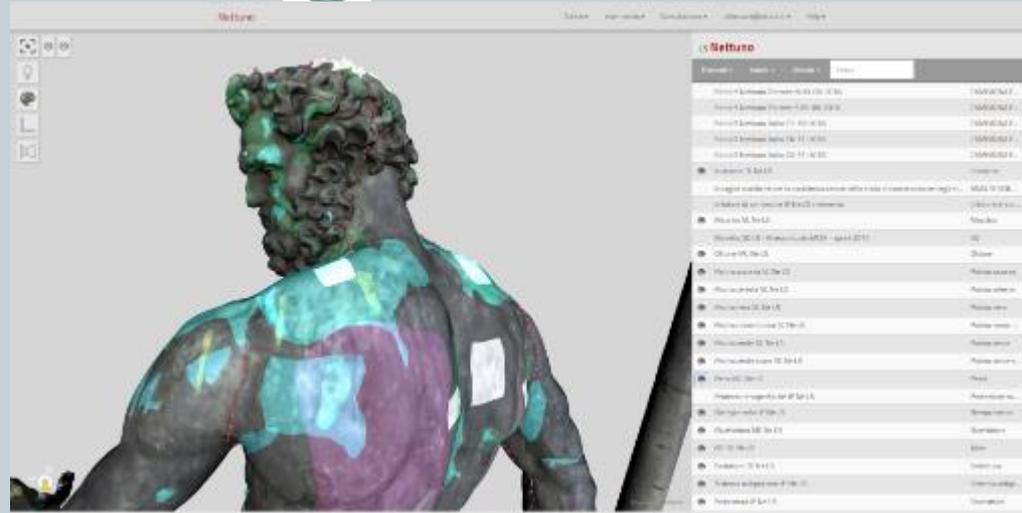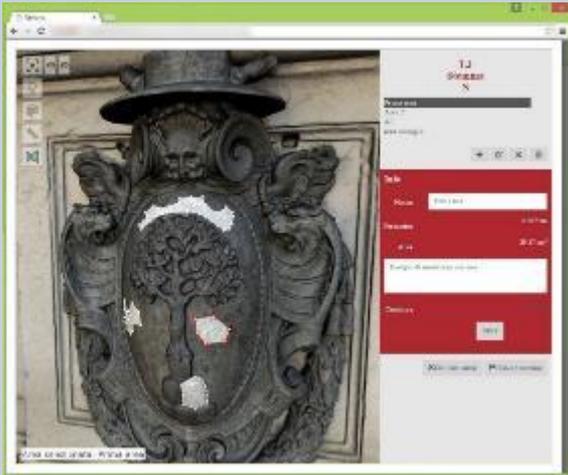
# Beyond 3DHOP

Without having to code

Visual Media Service

online repository with viewers for 3D models, RTI and large images.

Specialized, configurable viewers

Authoring tools for models/image enrichment

https://visual.ariadne-infrastructure.eu/
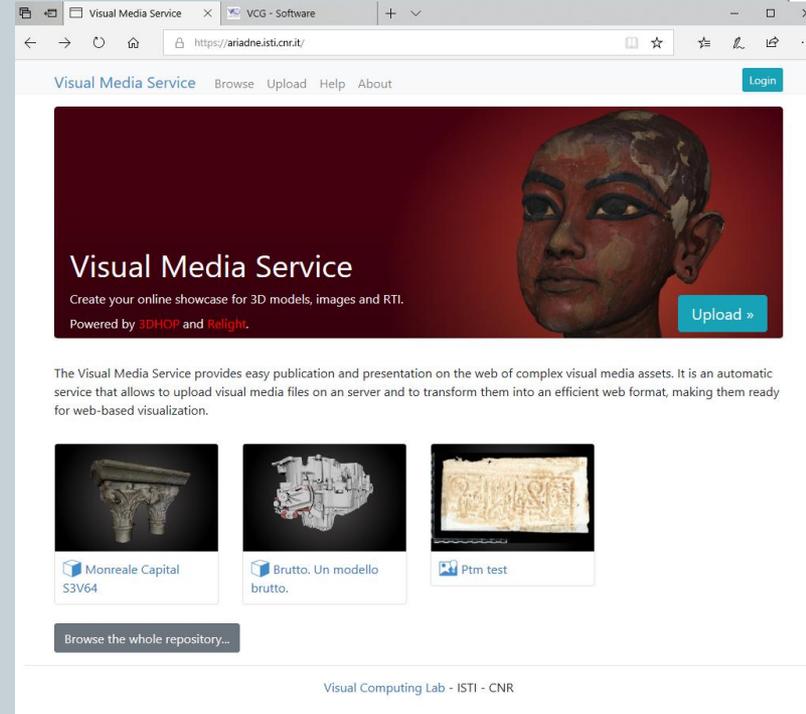
Nexus & Friends

Part of the potentiality of 3DHOP is the ability of working with high-res geometry.

3DHOP is a good piece of software, but it is not a solution for all the problems of the world.

So why not bringing the power of multires 3D into other tools/libraries/environments ?

- NEXUS in three.js
- NEXUS with Potree
- NEXUS in unity?

After 3DHOP, VR-HOP?

We already have a powerful multresolution web-enabled engine...

Using WebVR and THREE.js we can build web-based VR apps using high-res geometry.

GOOD: works in streaminng, works on many devices

BAD: you are completely on your own, same limitation of web apps.

We created a «template» for simple scenes (much more limited than 3DHOP), and for «explorable environments»

Basic scene
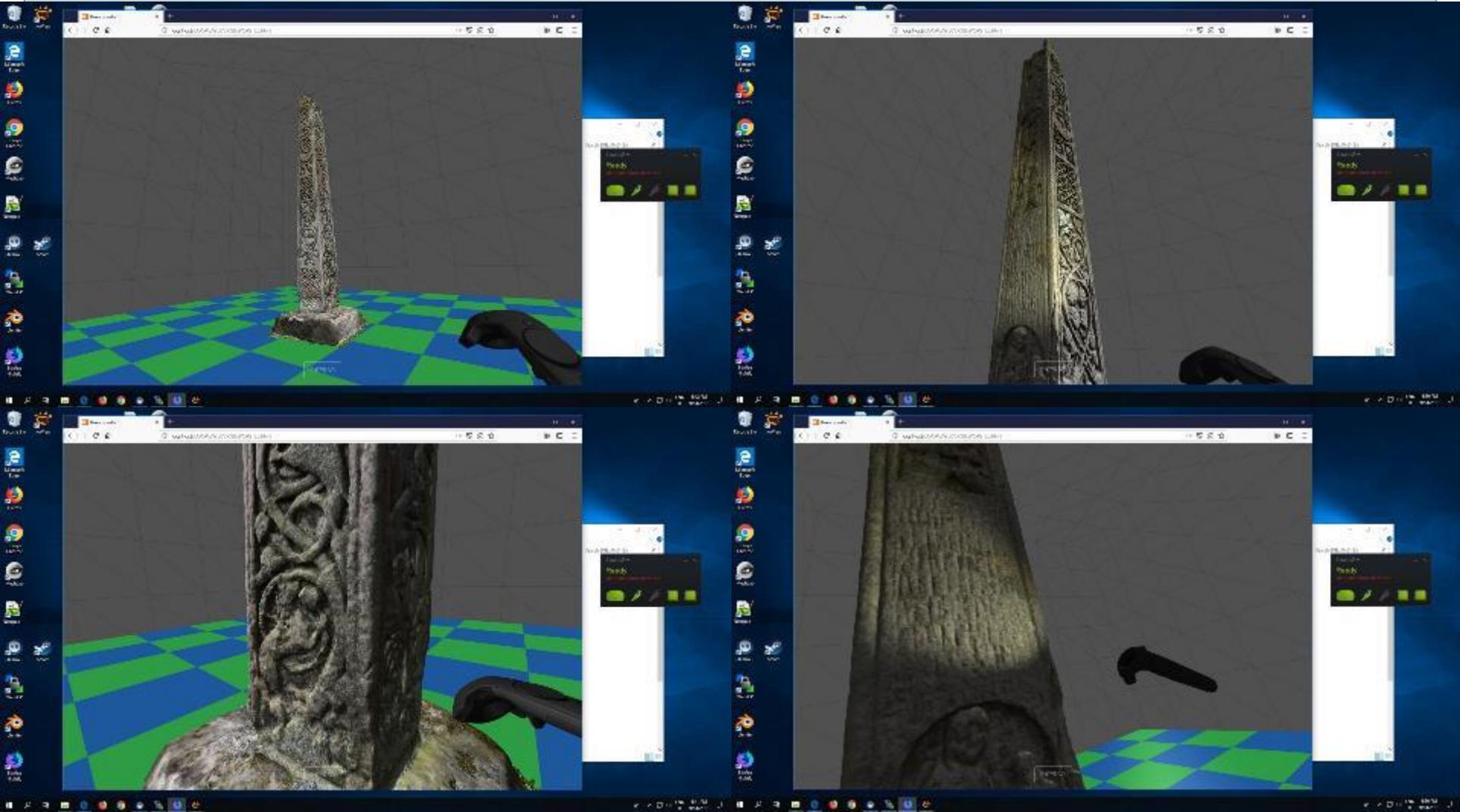
Indoor
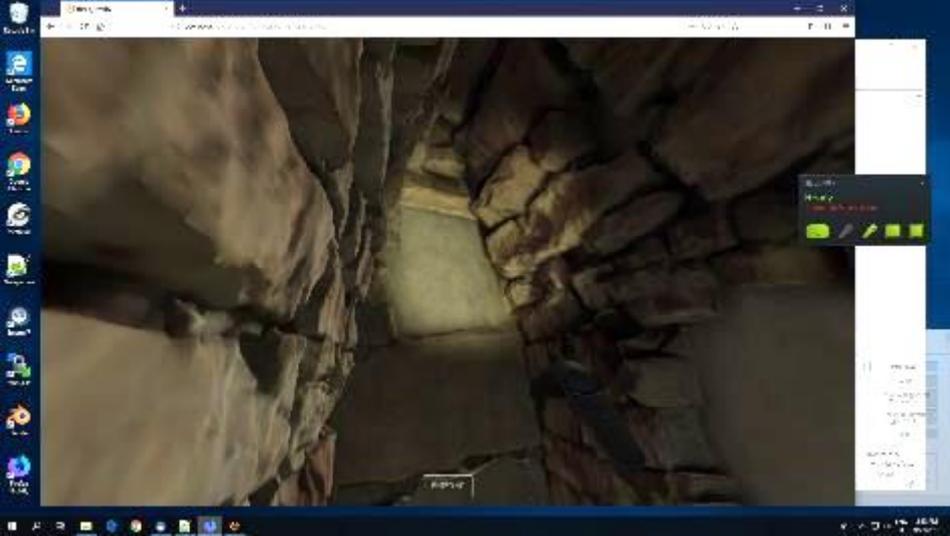
Thanks for your attention…

CONTACTS & QUESTION TIME

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`www.3dhop.net`