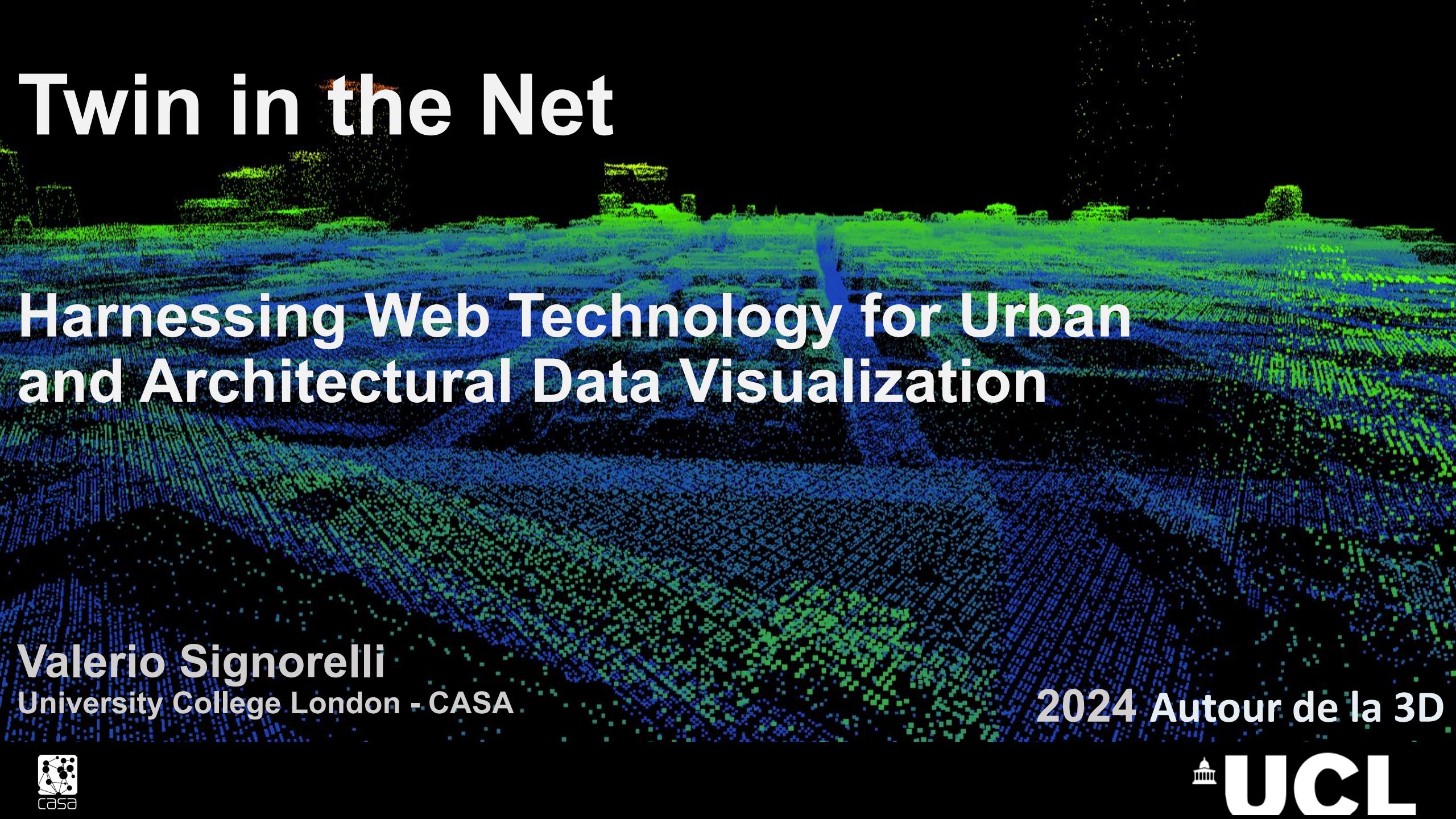


# Twin in the Net



**Harnessing Web Technology for Urban  
and Architectural Data Visualization**

**Valerio Signorelli**  
University College London - CASA

2024 Autour de la 3D





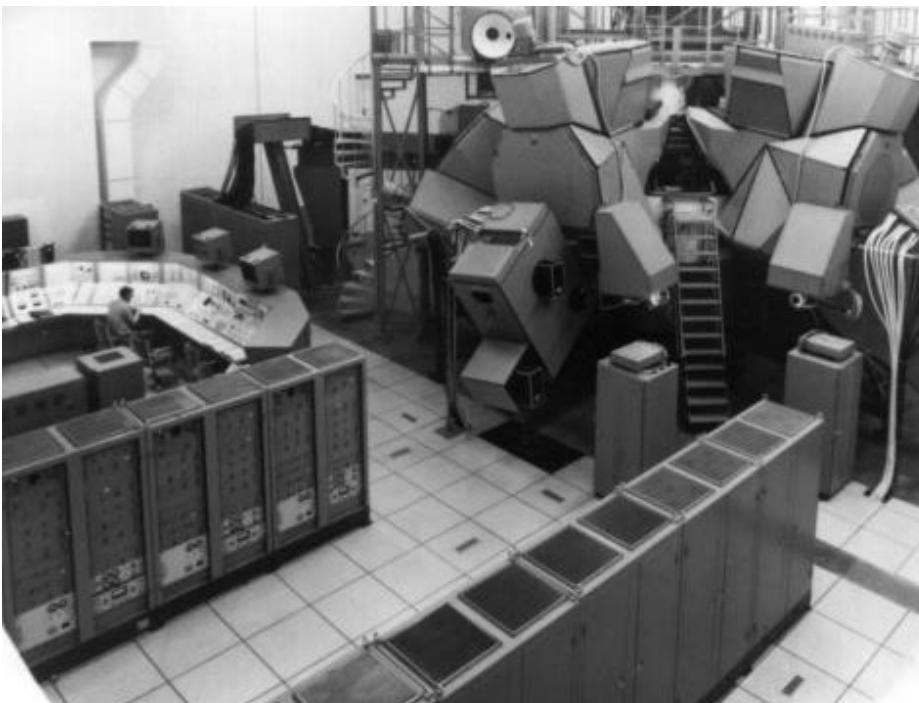
# Digital Twin

“A live digital coupling of the state of a physical asset or process to a virtual representation with a functional output” (Advanced Manufacturing Research Centre, in Boyes & Watson 2022:3)

*“Okay, Houston... we've had a problem here” – very little digital*



*Jim Lovell descends from the Command Module simulator at KSC in 1970*



Apollo Command Module Simulator with associated computer equipment. The simulator control station is to the left.

## Digital Twins for...

Manufacturing	Telecommunications
Automotive	Maritime Operations
Energy	Oil and Gas Industry
Aeronautics	Retail
Renewable Energy	Public Safety
Built Environment	Education
Industrial	Entertainment
Production	Sports
Medical Field	...
Aerospace	
Commercial Field	
Agriculture	
PLM	

# Interface as a tool

“A live digital coupling of the state of a physical asset, or process, to a virtual representation with a **functional output**” (Advanced Manufacturing Research Centre, in Boyes & Watson 2022:3)

## Functional output

information transmitted to a system or human observer that is actionable to deliver value

### User Interface

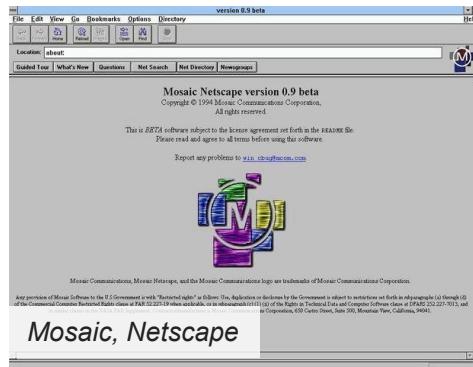
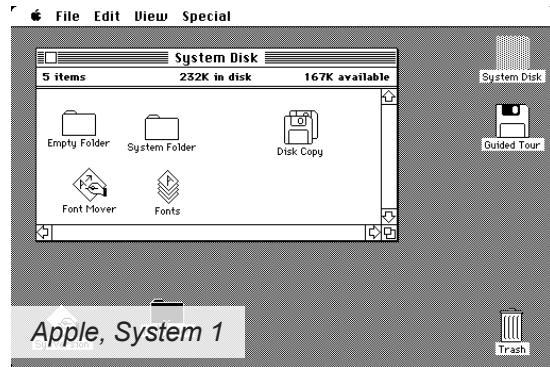
Digital Twin Output

DT configuration - control

2D Representation

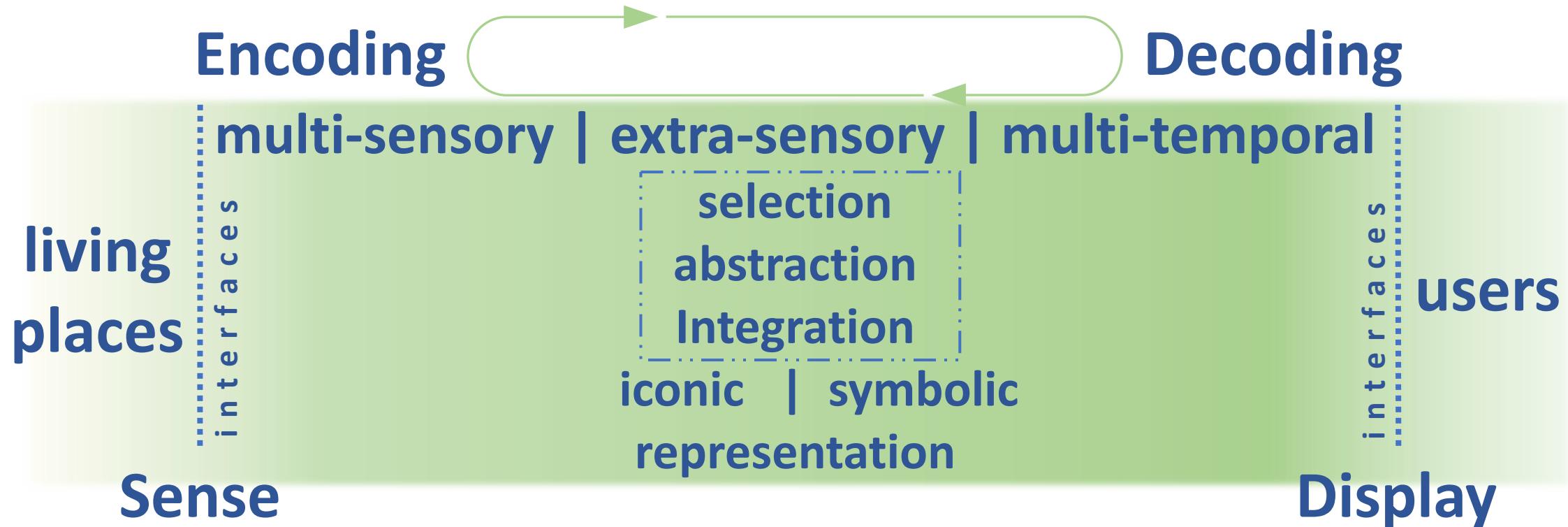
3D Representation

Dashboard



# Interface as an effect

"The interface is this state of "**being on the boundary.**" It is that moment where one significant material is understood as distinct from another significant material. In other words, an interface is not a thing, **an interface is always an effect. It is always a process or a translation.**" (Galloway, 2008:939)



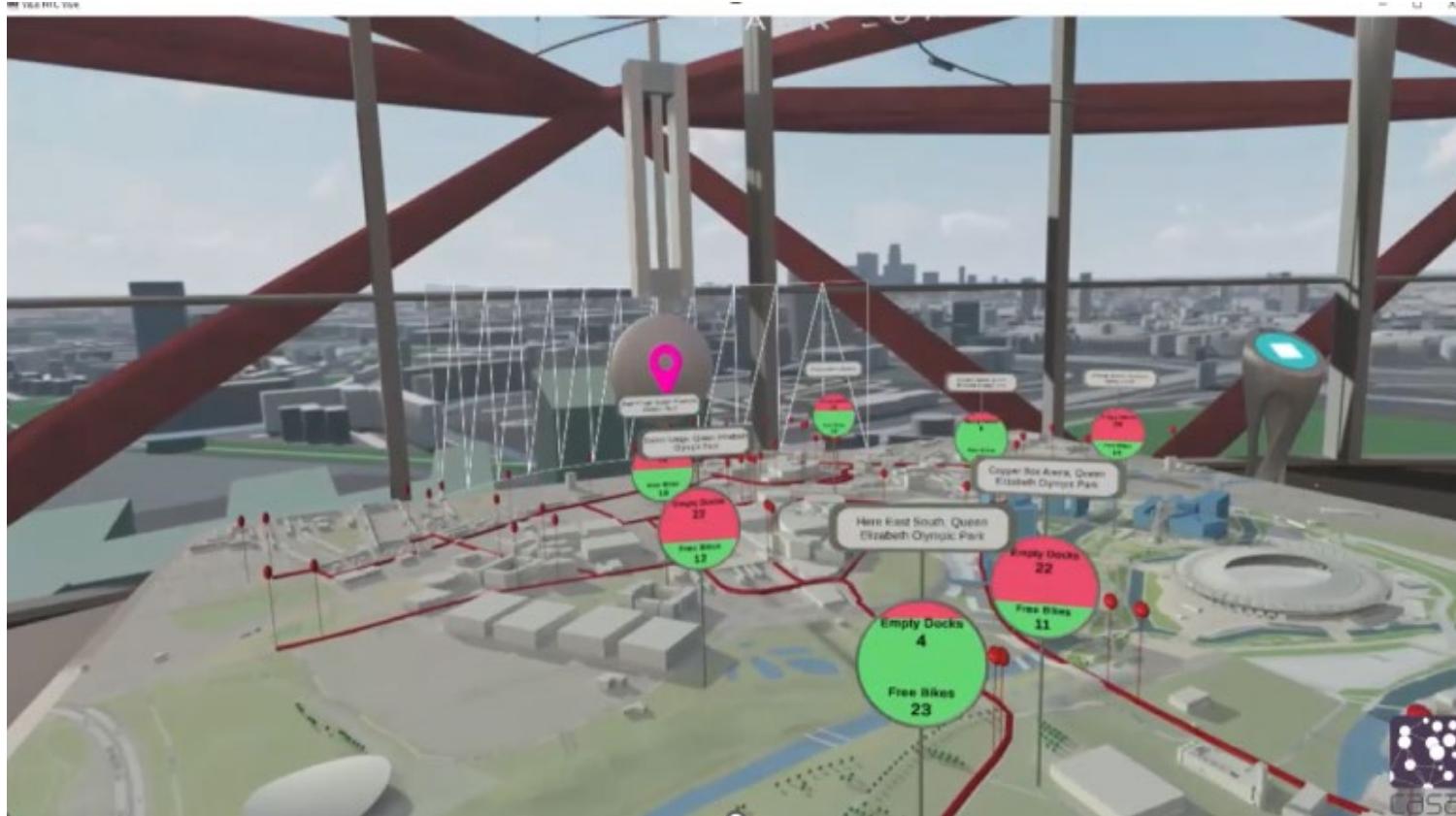
E/D continuum by Signorelli V. 2021. CC BY 4.0



VIRTUAL LONDON

# Playing the Archive

# Digital Innovation for Data Visualisations in Participatory Urban Planning

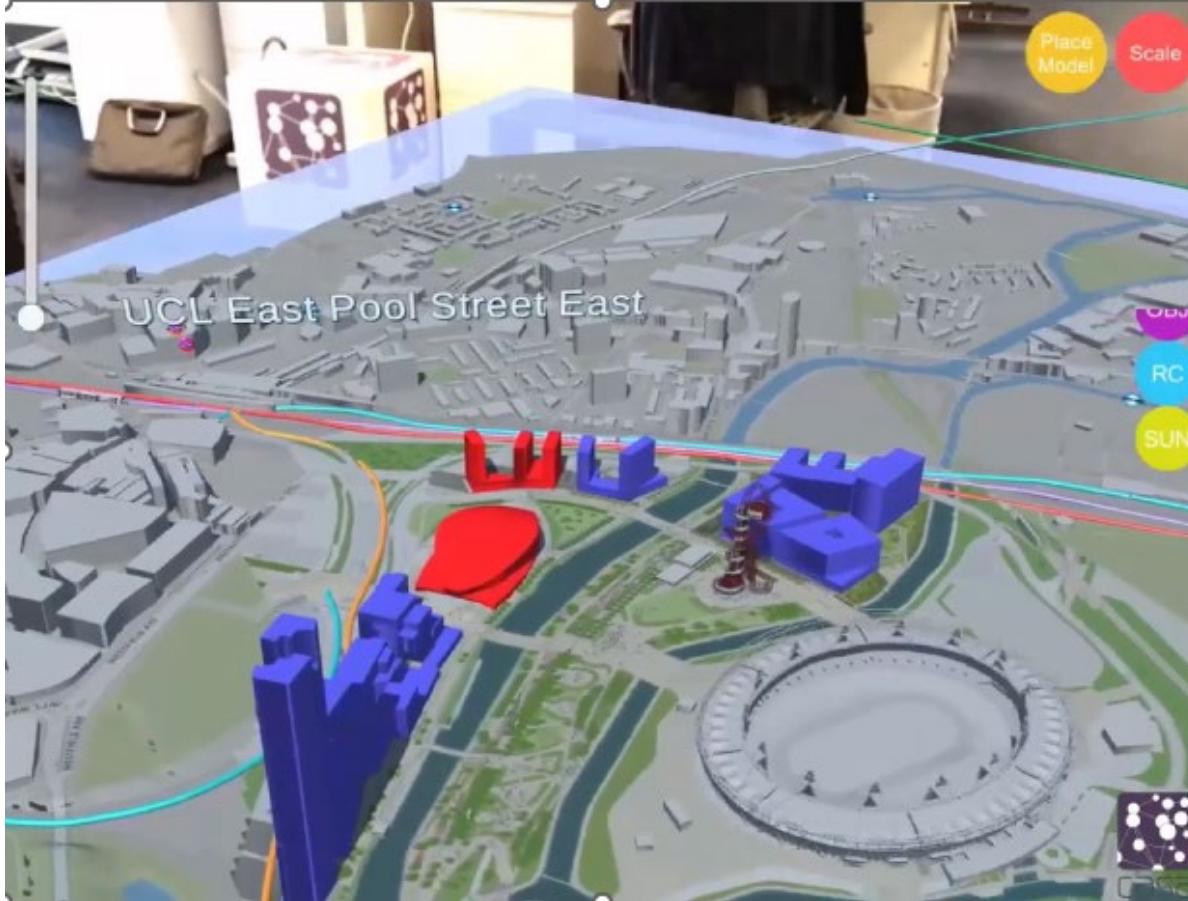
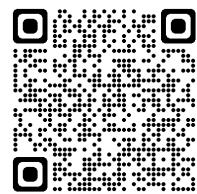


<https://youtu.be/GbGiXxWYfj4>

- To visualise and analyse geospatial-temporal urban, social and economic datasets in an interactive digital environment;
- To test interactive, collaborative and engaging media for delivering near real-time geospatial dataset;
- Working on multi-scalar environments, from the Building to the City;



# Digital Innovation for Data Visualisations in Participatory Urban Planning

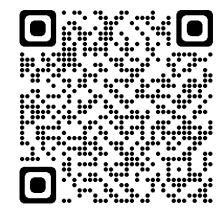


<https://youtu.be/jDQ2YOf8ynE>

- To explore the role of XR interfaces and their interconnectedness in urban practices (e.g., from public participation to planning activities);
- Introducing analytical capabilities within a visualization tool;
- Leveraging cloud technologies (e.g., Firebase, PostGIS) to synchronize and keep various modules of the platform updated.

# Playing the Archive

Memory, Community and Mixed Reality Play

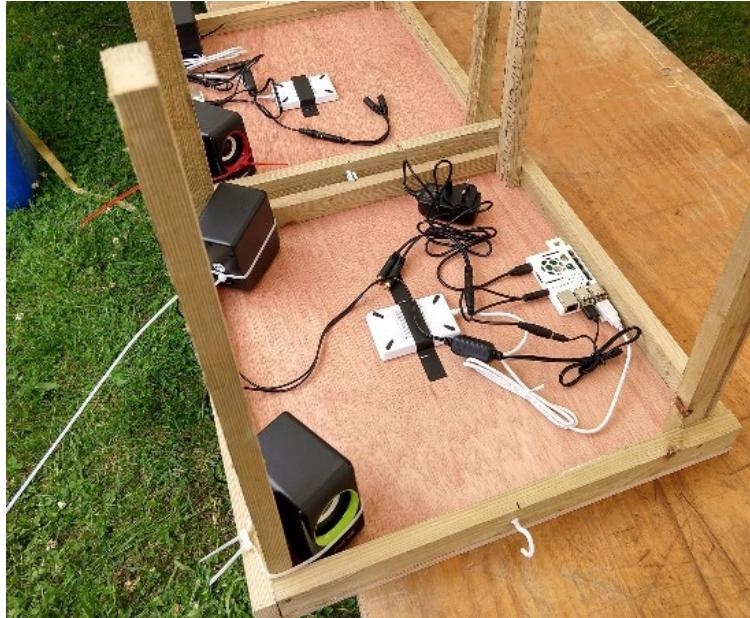
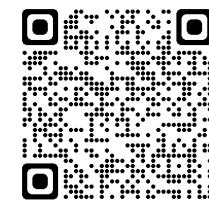


## Time Telephone

use every day interfaces enhanced with digital computing technologies to communicate and preserve the fragile and ephemeral cultural memories of play

# Playing the Archive

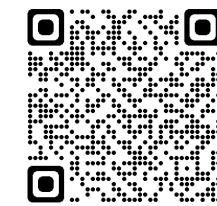
Memory, Community and Mixed Reality Play



## Memory Safe

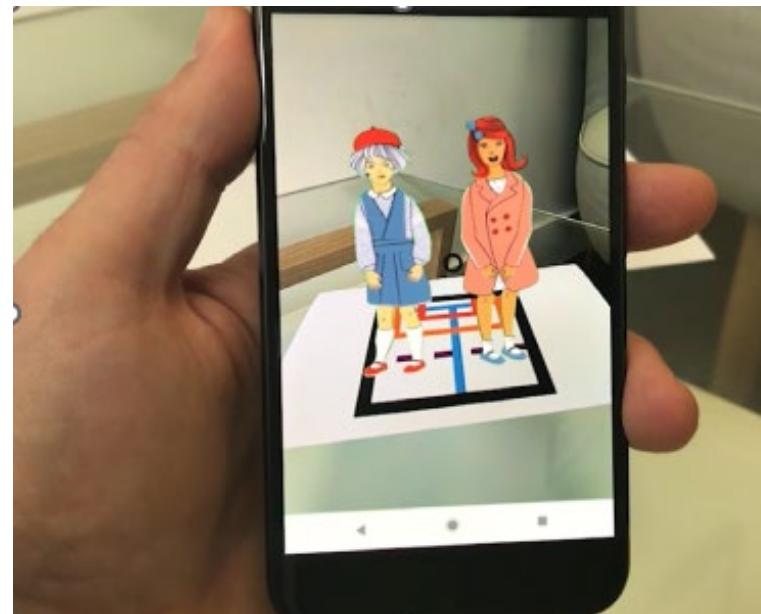
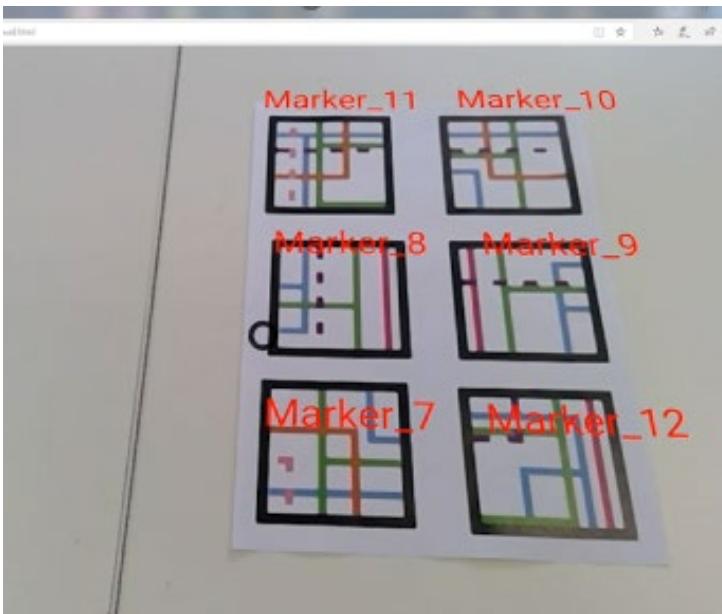
Explore migration memories through objects left behind—items like toys, a clock, tea cups, shells, and a biscuit tin tell participants' stories, capturing lost childhood, relocation to the UK, and memories of objects lost in transit.

# Playing the Archive



Memory, Community and Mixed Reality Play

[https://youtu.be/AvrHxGVGoPQ?si=bo3\\_5xplZecpr8xx](https://youtu.be/AvrHxGVGoPQ?si=bo3_5xplZecpr8xx)



**Kick ball fly**

---

1. Choose a player to be **ON**.
2. Place the ball on the ground at an **agreed spot**, such as a chalk circle, to show where the ball must be returned to.
3. Whoever is on **kicks or throws the ball** as far as they can and calls out the name of another player.
4. That player has to **run after the ball** and **return it to the marked spot** walking backwards.
5. The rest of the players find somewhere to **hide**.
6. The player that **collected the ball** becomes the **seeker** and has to find the other players.
7. If they see another player, they **shout their name** and the two players have to race back to the ball.
8. If the seeker gets there first the other player is **out**. This continues until all those who have been hiding are out.

---

**Kick ball fly**

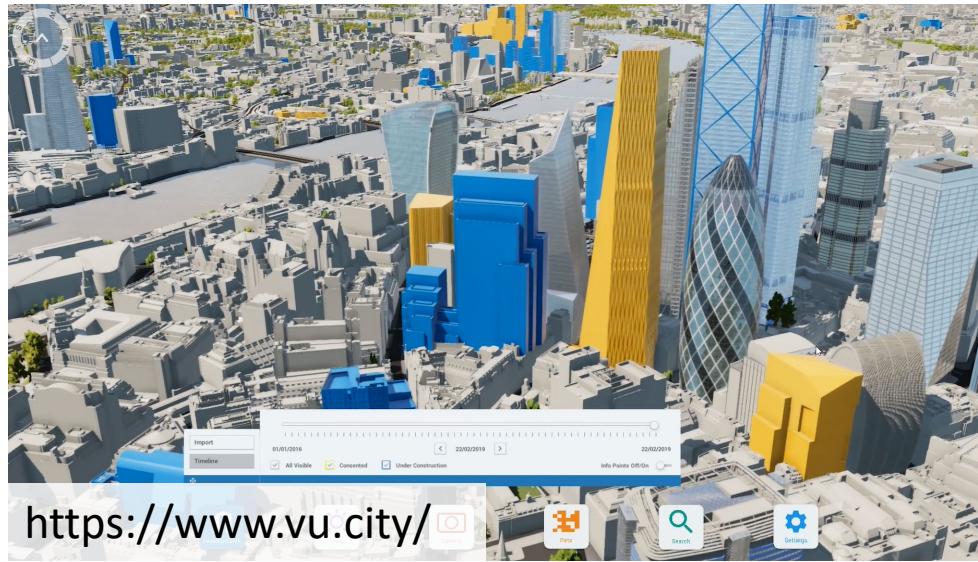
---

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## Sense of Play

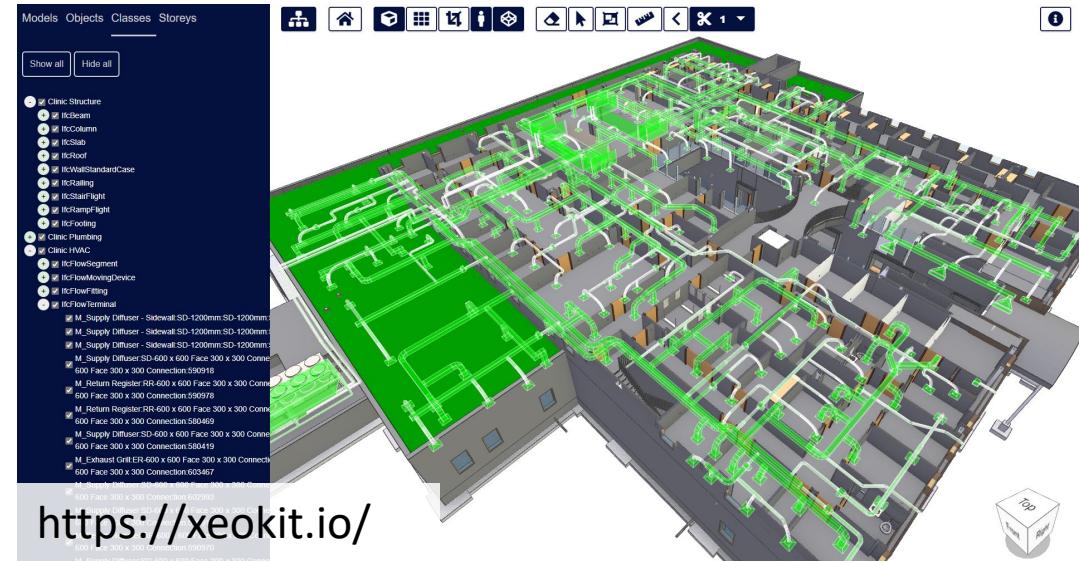
Conveying play activities through digital materiality, linking historical archives with play cards and WebAR interfaces.

# Web Based Geospatial Platform



<https://www.vu.city/>

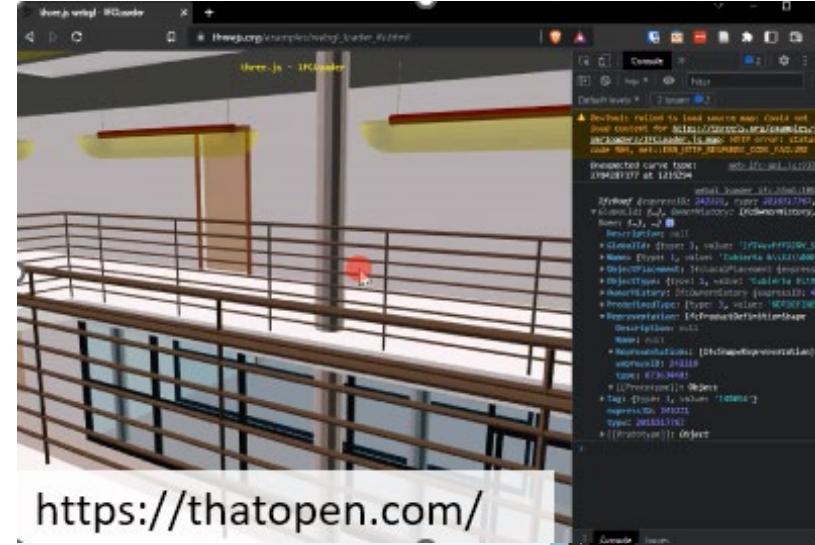
# Web Based BIM Platform



<https://xeokit.io/>



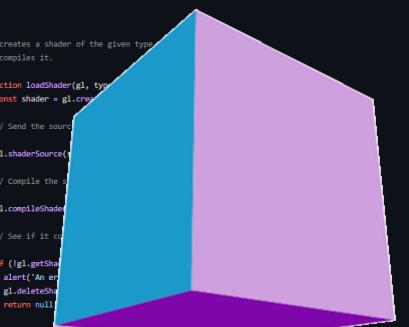
<https://terria.io/>



<https://thatopen.com/>



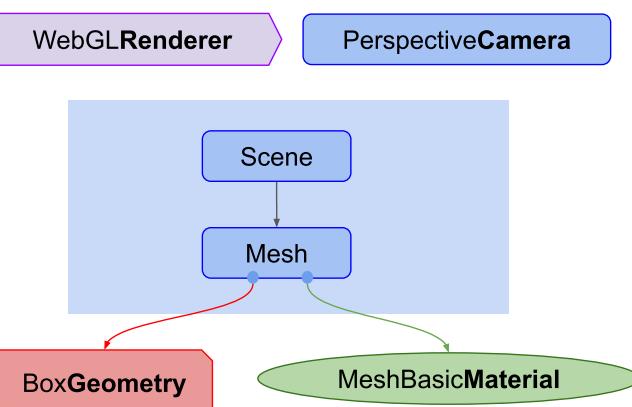
WebGL (Web Graphics Library) 2011 – Khronos Group  
*draws points, lines, and triangles. Getting WebGL to do anything else is up to you to provide code to use points, lines, and triangles to accomplish your task. Low-level library*



# HTML

```
<html lang="en" dir="ltr">
<head>
  <title>Three.js Hello World!</title>
  <style>
    body { margin: 0; }
    canvas { width: 100%; height: 100% }
  </style>

<!-- Three.js local --&gt;
  &lt;script src="js/three.min.js"&gt;&lt;/script&gt;
&lt;/head&gt;
&lt;body&gt;
  &lt;script src="js/example.js"&gt;&lt;/script&gt;
&lt;/body&gt;
&lt;/html&gt;</pre>
```



# JavaScript

```
var scene = new THREE.Scene();
var camera = new THREE.PerspectiveCamera( 75, 1 , 0.1, 1000 );
camera.position.z = 4;

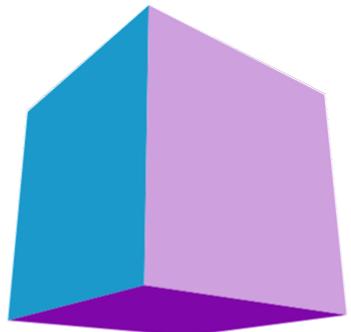
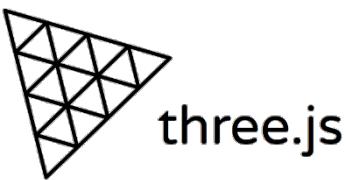
var renderer = new THREE.WebGLRenderer({antialias:true});
renderer.setSize( window.innerWidth, window.innerHeight );

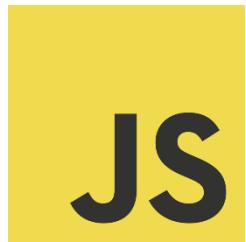
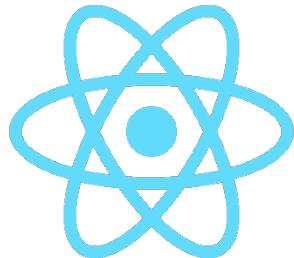
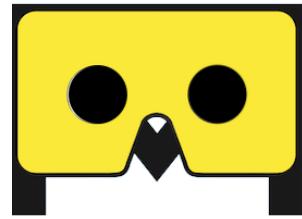
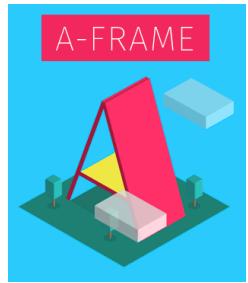
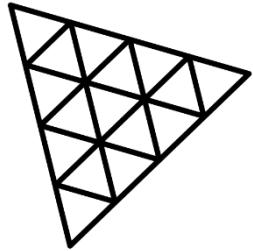
document.body.appendChild( renderer.domElement );

var geometry = new THREE.BoxGeometry( 1, 1, 1 );
var material = new THREE.MeshBasicMaterial( { color: "#433F81" } );
var cube = new THREE.Mesh( geometry, material );

scene.add( cube );

renderer.render(scene, camera);
```

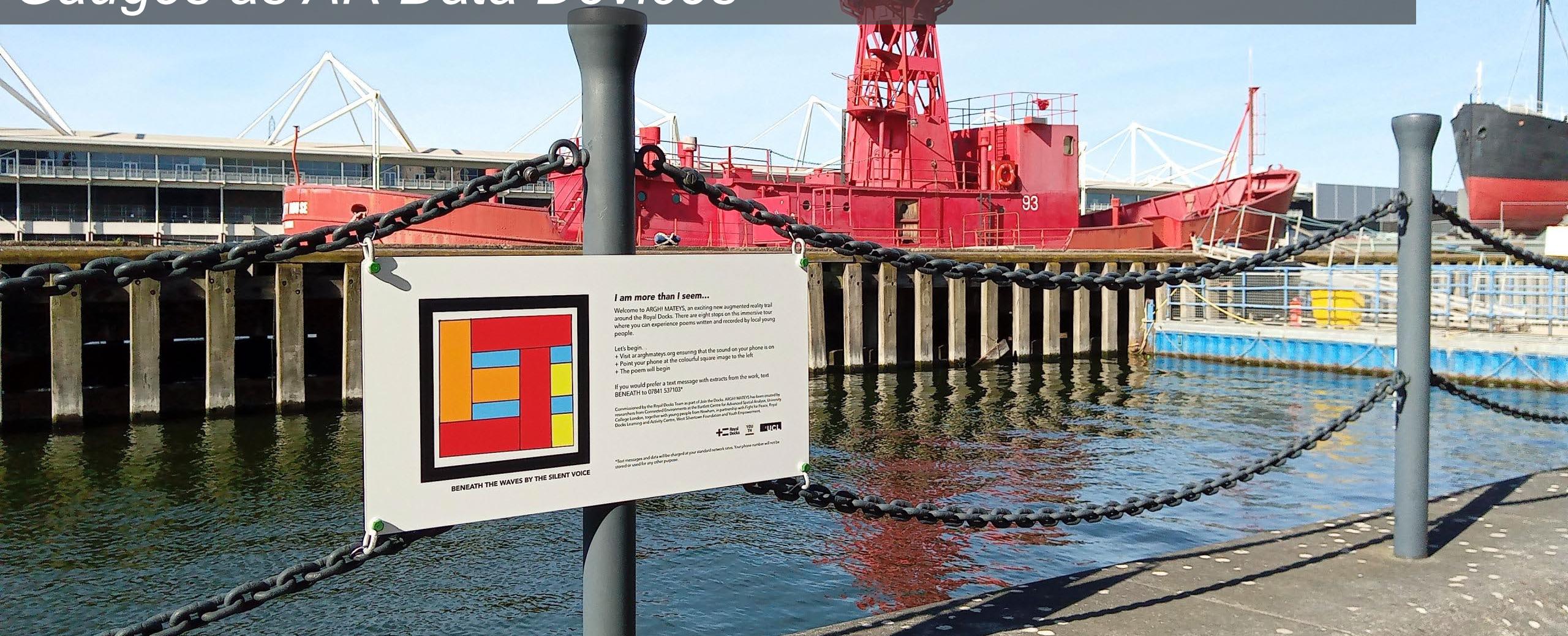
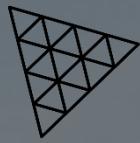
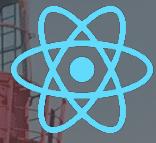




Many more...

# GARDD

## Gauges as AR Data Devices



# Data Device

*translate data into a more intelligible  
piece of information*



<https://youtube.com/shorts/xtA6YMradoE>

# Technologies involved



## Message Queuing Telemetry Transport

Low Bandwidth and lightweight messages Publish-Subscribe (Pub Sub)

Immediate Updates without having to poll a server

Small Messages as String (e.g. JSON), Number, Binary Data

The screenshot shows the MQTT Explorer application interface. The left sidebar lists topics under UCL, including 90TCR (18 topics, 35 messages), PSW, Garden, WST, and dvp2. The dvp2 topic is expanded, showing a JSON message payload with various environmental parameters like date, barometer, temperature, humidity, wind, rain, and leaf wetness. The main panel shows a breadcrumb navigation path: UCL / PSW / Garden / WST / dvp2. Below the path are sections for Value (with a slider) and History (with a dropdown menu). At the bottom, there's a Publish section with a Topic field set to UCL/PSW/Garden/WST/dvp2.



FBX 5mb



GLB 800kb

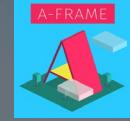
# GAARD



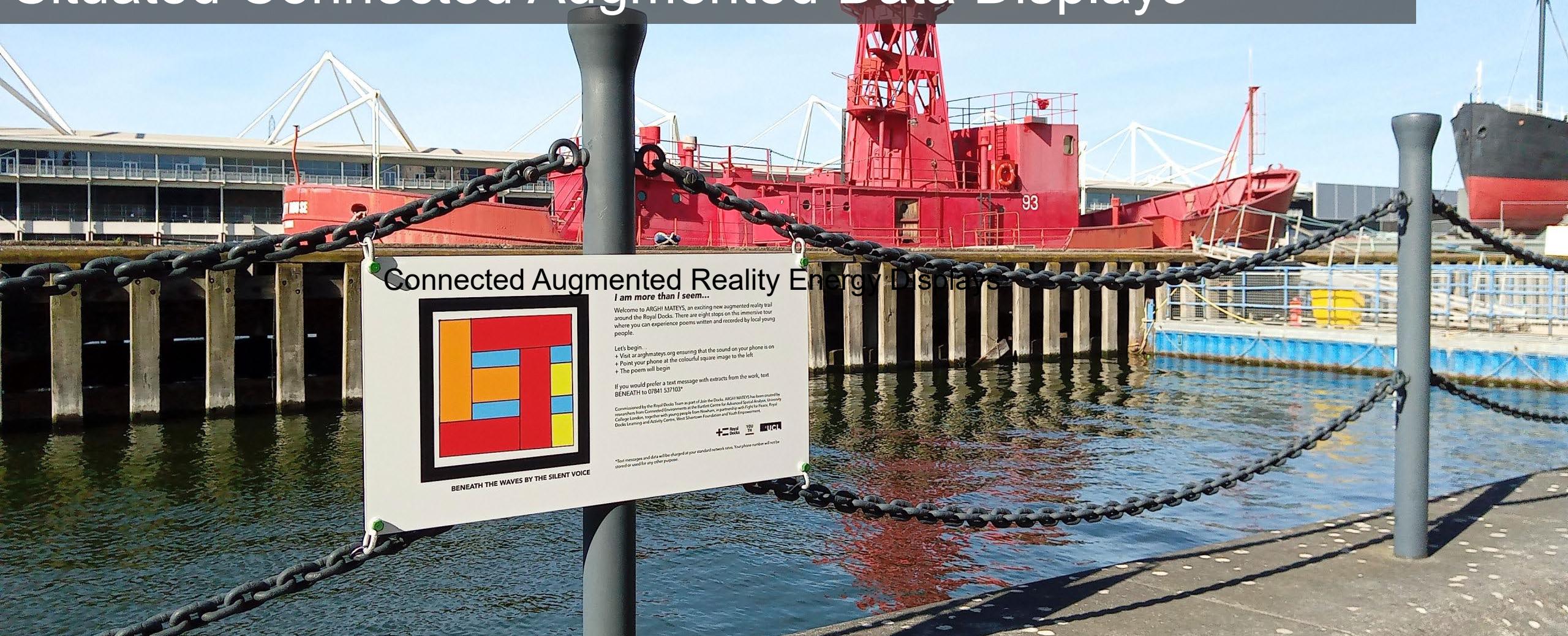
<https://youtube.com/shorts/oSa18oRWDWQ?feature=share>

# SiCADD

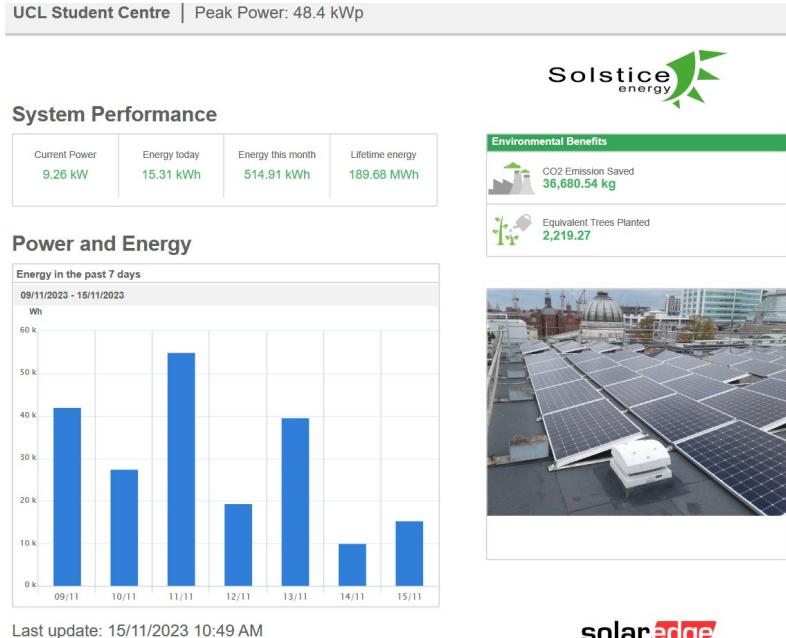
## Situated Connected Augmented Data Displays



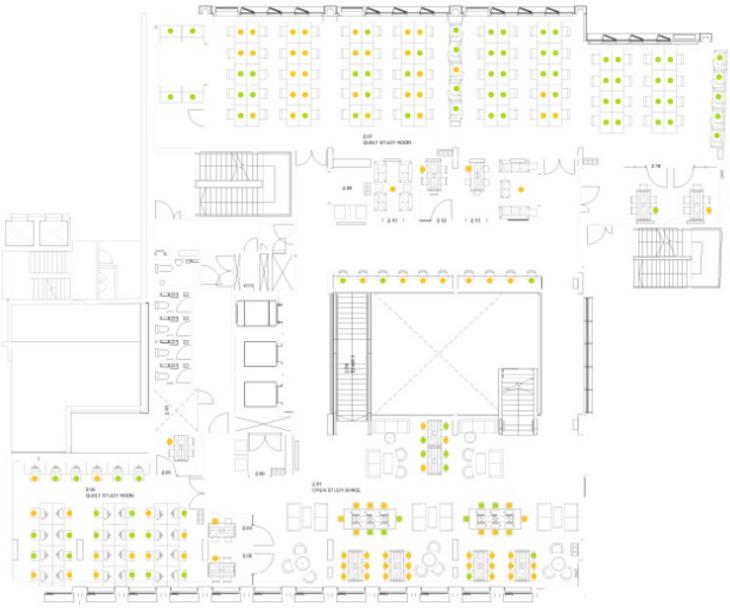
ECHARTS  
MQTT.js



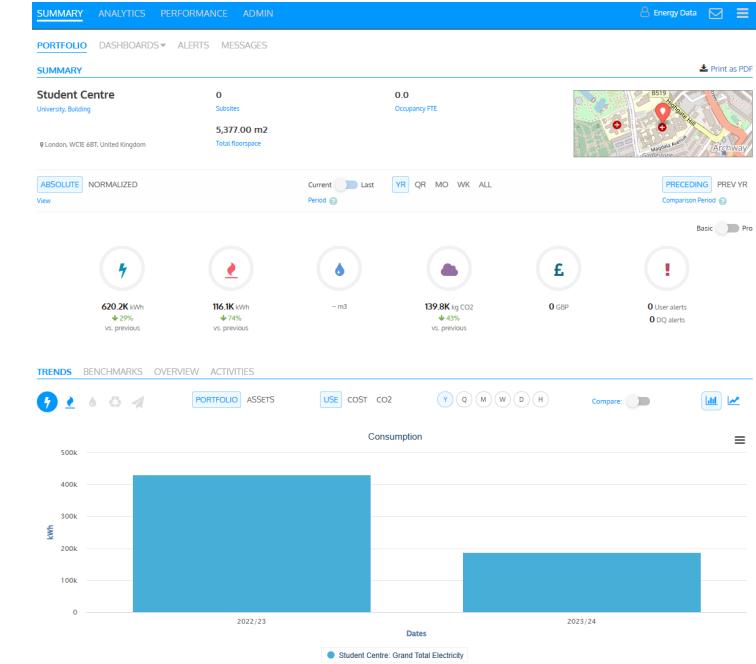
# Bring data back to space



Solar Power Data



Occupancy data



# Bring data back to space



Gzy84c, CC BY-SA 3.0 via Wikimedia Commons



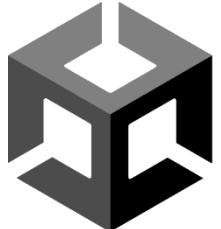
Bloomberg Terminal



CityDashboard (2012) <https://citydashboard.org/london>

# Bring data back to space

SiCADD is employed to showcase real-time information related to building operational data provided by BMS (Building Management System), such as energy consumption, temperature data, and air quality. The aim is to return this data to the space where it was initially generated, along with additional on-site analyses.

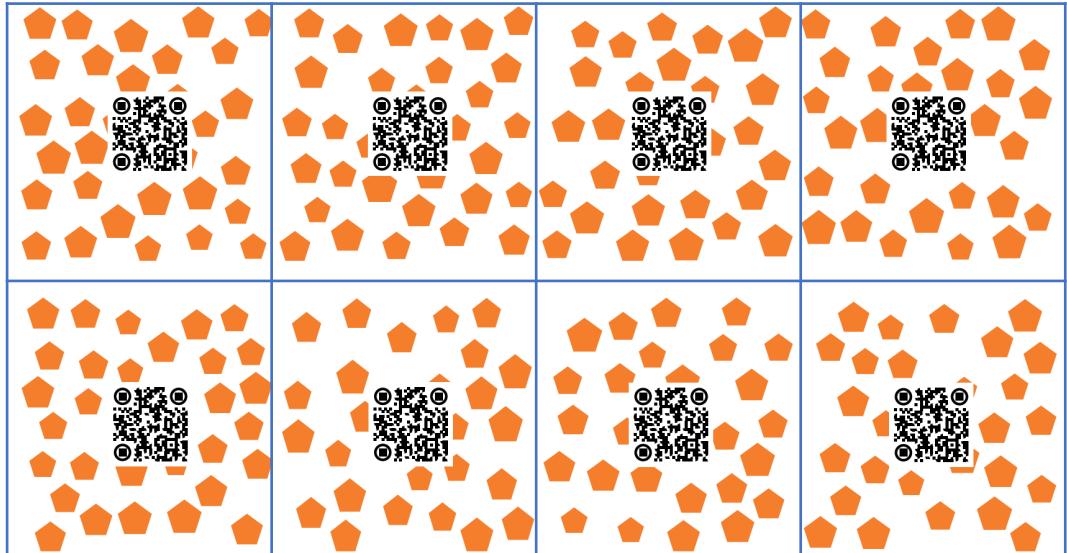


m2mqtt

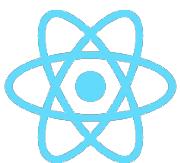


<https://youtube.com/shorts/j60FI5GBtT0>

# Bring data back to space

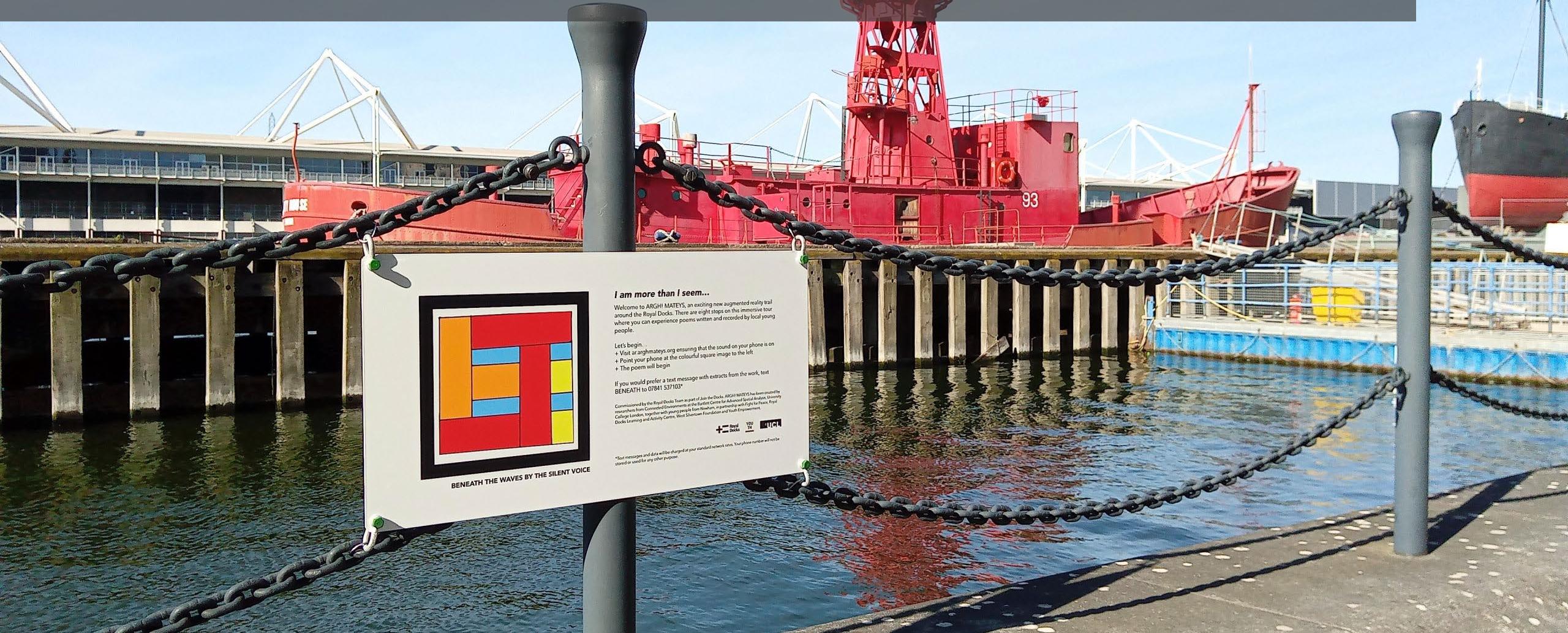
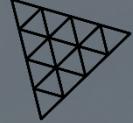


Markers are used to access the WebApp and trigger data



<https://youtu.be/FgjMjfwpaw>

# Immersive WebAR



# Mobile AR

A WebAR demo using ThreeJS and [NYTimes three-loader-3dtiles](#) using Freeman Alley, New York 3D photogrammetry model.



<https://youtube.com/shorts/t3ADMmN3grw>

# What's next

- **The future of WebXR is promising, but challenges persist.**  
Experimental, and not all major platforms supported (...Apple)
- **Solely relying on the web is a double-edged sword.**  
rapid prototyping and distribution vs over-reliance on cloud solutions, network accessibility, libraries and frameworks support, and interoperability.
- **The major limit is always data**  
input data and standards. The production of data is more time-consuming than its visualization.

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<https://github.com/ucl-casa-ce/Open-Gauges>