MARKER-LESS MOBILE AUGMENTED REALITY APPLICATION FOR MASSIVE 3D POINT CLOUDS AND SEMANTICS

Abderrazzaq Kharroubi, Pr. Roland Billen, Dr. Florent Poux

Geomatics Unit, University of Liège, Belgium

XXIV ISPRS CONGRESS VIRTUAL EVENT

31 August - 2 September 2020

LIÈGE université
Geomatics

INTRODUCTION

DEVELOPED METHODOLOGY

AR IMPLEMENTATION

RESULTS AND DISCUSSION

FUTURE WORK

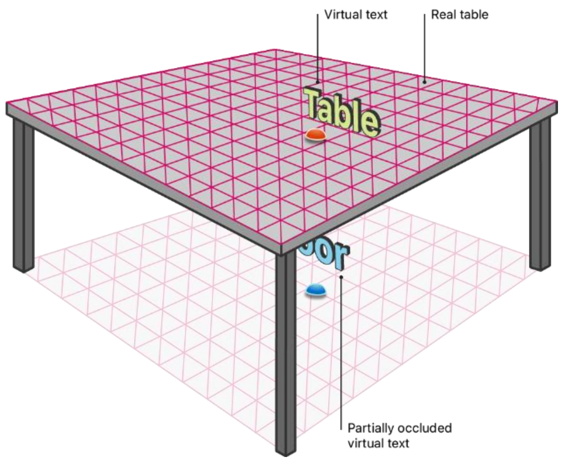
CONTEXT

Emergence of dedicated AR devices (Video See-Through, Optical See-Through)

Powerful Software Development Kit (e.g. ARCore for android and ARKit for iOS)

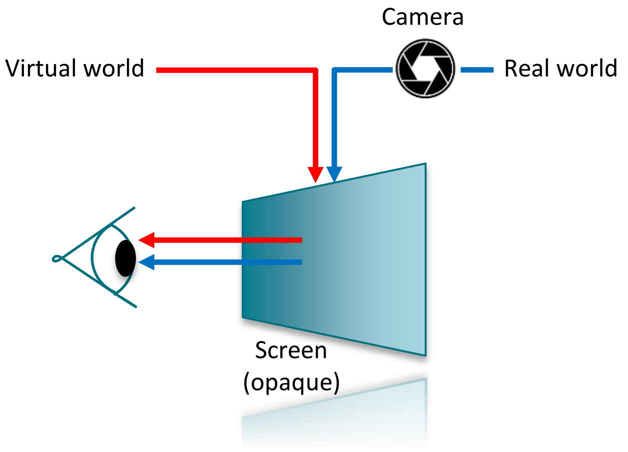
New sensors integration (e.g. LIDAR for iPad Pro)

More advances in computer vision (e.g. Occlusion, Scene Understanding)



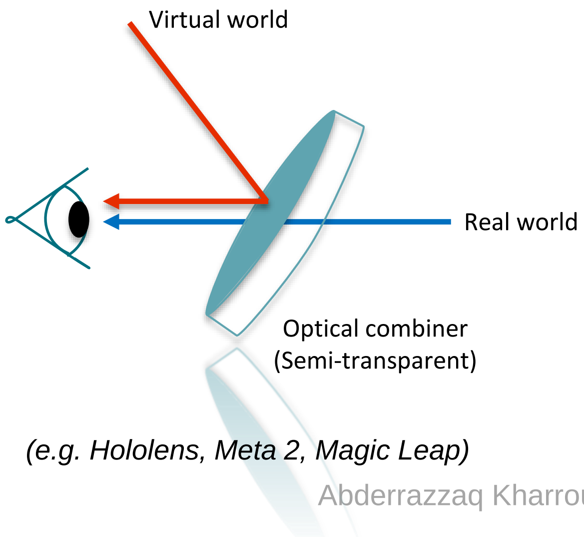
Advanced Scene Understanding in AR
<https://developer.apple.com/documentation/arkit/world_tracking/visualizing_and_interacting_with_a_reconstructed_scene>

Video See-Through



(e.g. Your Smartphone, Gear VR)

Optical See-Through



(e.g. Hololens, Meta 2, Magic Leap)

ARKit 4 By Apple (2020)
<https://developer.apple.com/augmented-reality/arkit/>

ARCore By Google
<https://arvr.google.com/arcore/>

Apple iPad Pro Lidar Scanner (2020)
<https://www.apple.com/befr/ipad-pro/>

GOALS

To open on new AR applications and investigates new ways to better integrate massive 3D datasets and semantics through web-based mobile AR.

→ Investigate challenges linked to point cloud data structure and semantic injection ?

→ Cross platform AR solution ?

High-level 3D models

(point clouds & semantics)

+

AR

METHOD

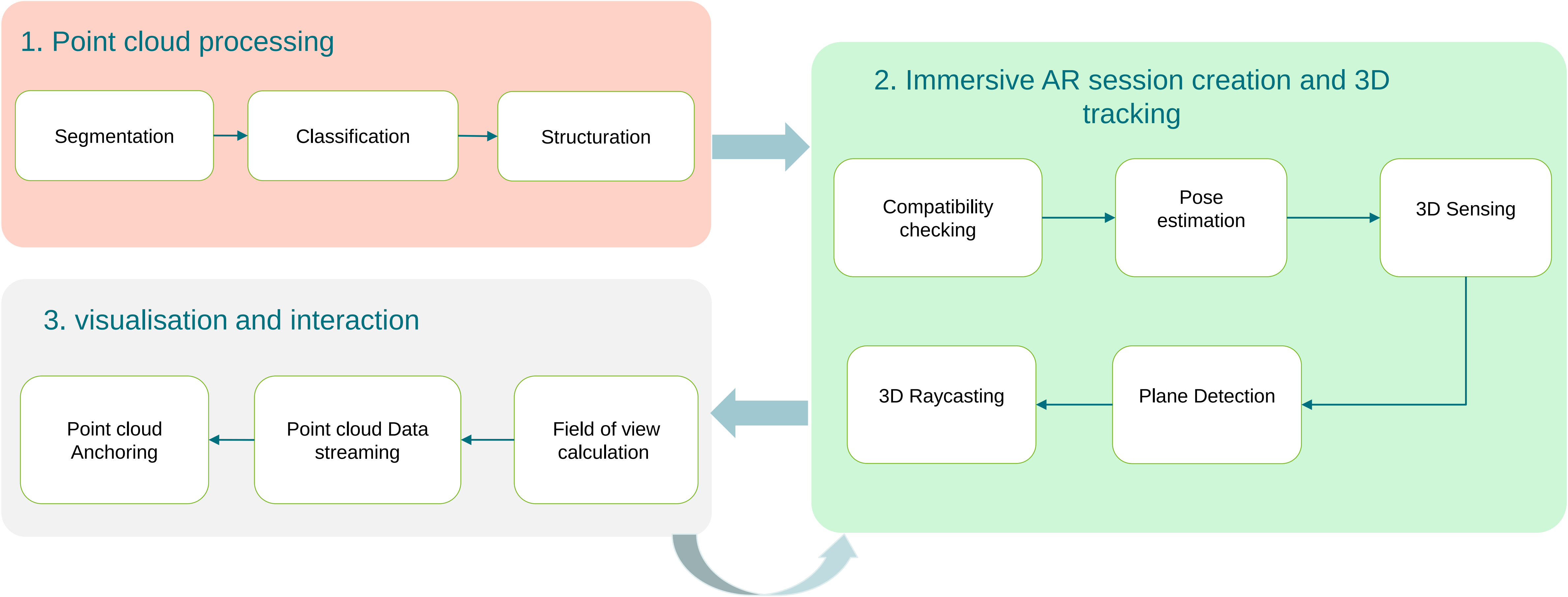


Figure 1. A general workflow of the followed methodology

Method

Segmentation was done semi-automatically on CloudCompare, assisted by the following automatic plugins:

- RANSAC Shape Detection (Schnabel et al., 2007),
- CSF based on the cloth simulation filter developed by (Zhang et al., 2016),
- Histogram filtering,
- Label Connected Components,
- and CANUPO.

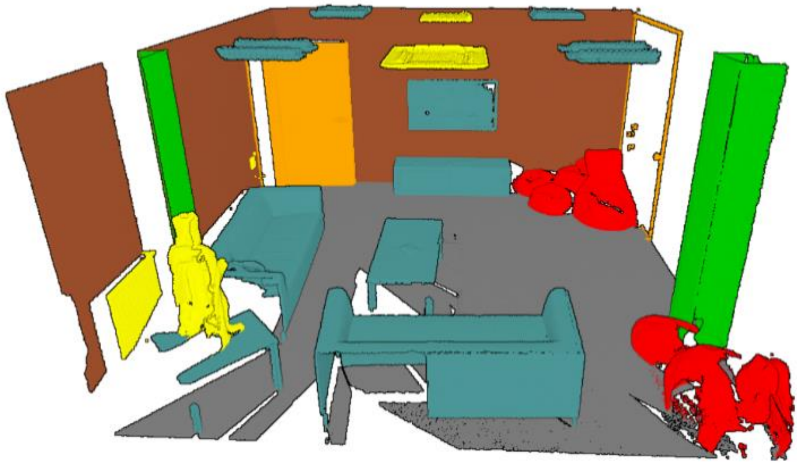
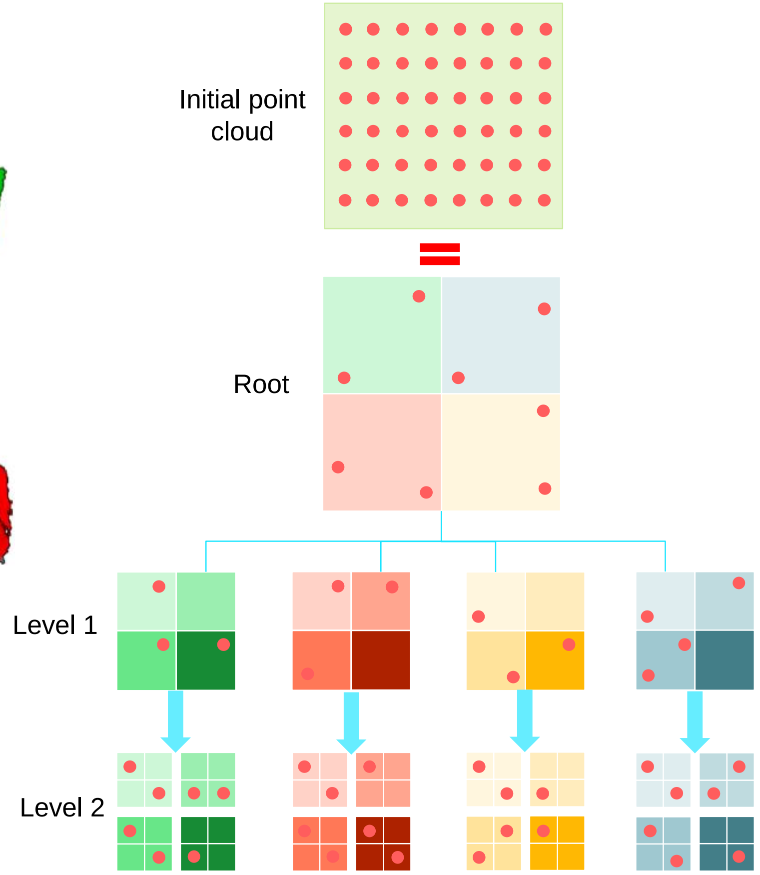


Figure 2. Classification results: a piece with different objects.



Potree.org
WebGL point cloud visualization

Figure 3. Potree's octree structure explained in 2D (Potree, 2020)

AR Implementation

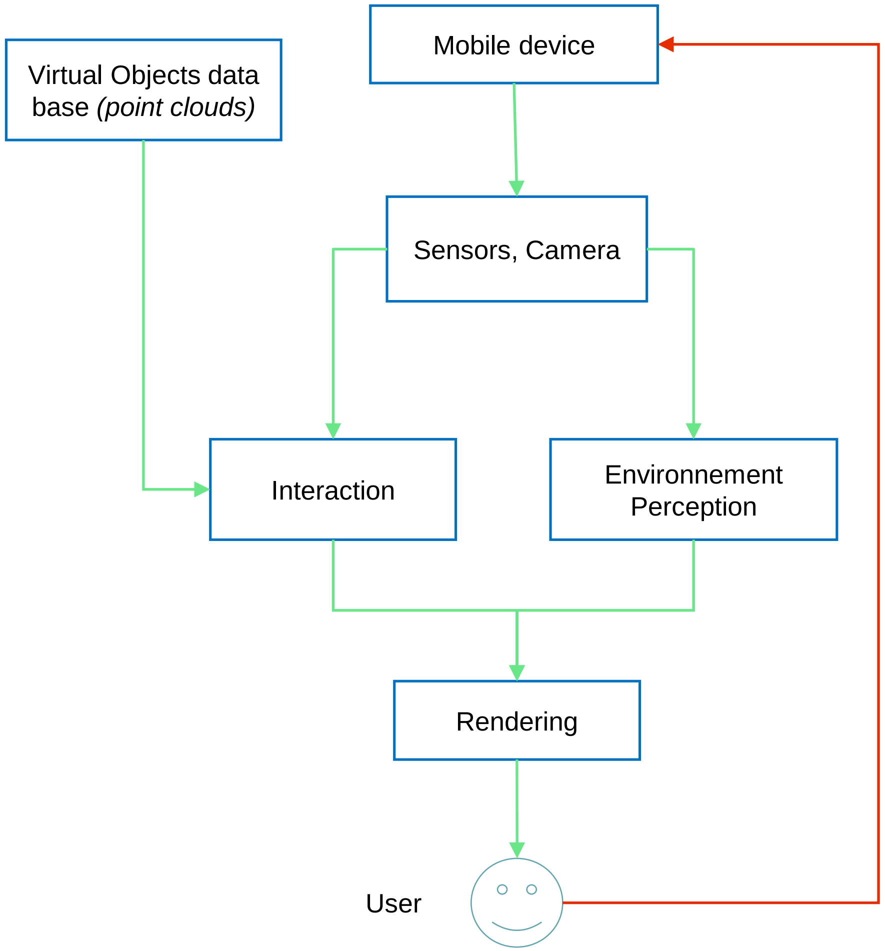


Figure 4. Mobile Augmented reality simplified process

1. Sensors-based

Based on the mobile device sensors

- Such as GPS, gyroscopes, magnetometers, compasses, accelerometers, and so on.
- The camera used only for the display of the environment as background
- Works in an open-loop way, which will result in an unavoidable cumulative error, since the tracking error cannot be evaluated and corrected in real time

2. Vision-based

Based on the camera

- The camera on the device captures the surrounding environment.
- It further provides the basis for vision-based object recognition, feature detection, and tracking.
- Uses feature correspondences to estimate pose information to align the virtual content with real-world objects and is analogous to a closed-loop system.
- Heavy computational pressure on mobile devices

3. Hybrid

Based on sensors and camera

- This is a compromised solution. It overcomes the weaknesses and limitations of the individual methods

Figure 5. Mobile Augmented reality implementation mechanisms

AR Implementation

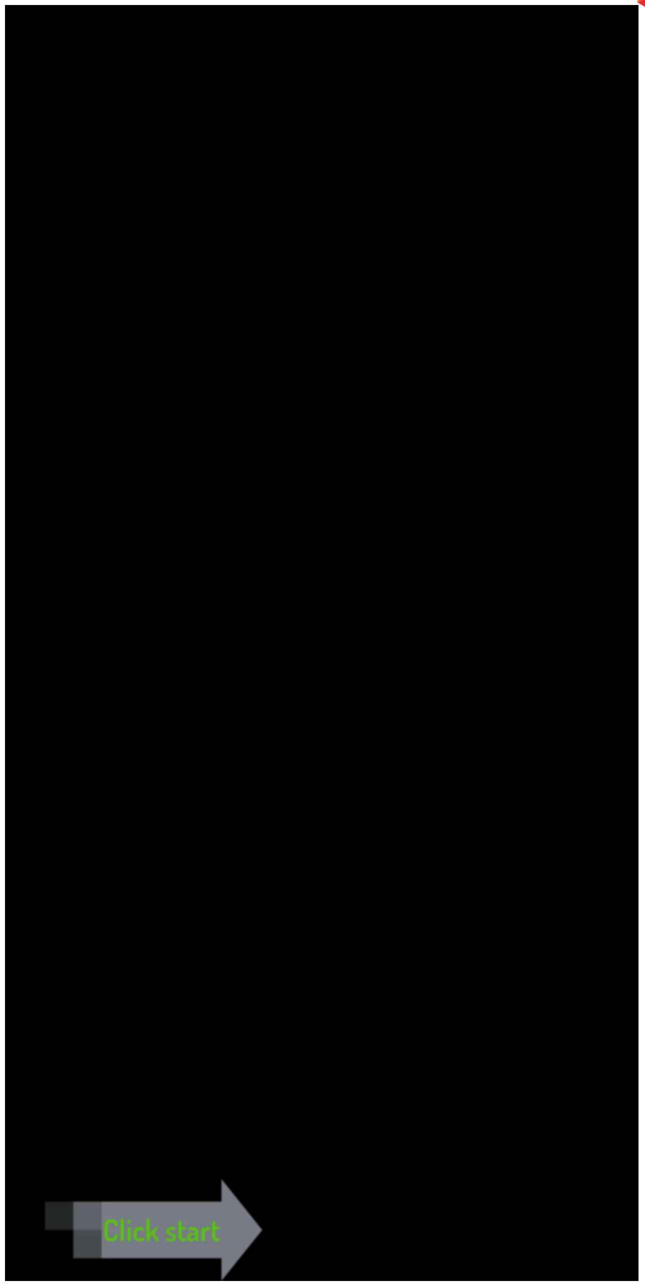
Three.js is a cross browser JavaScript library used to create and display animated 3D computer graphics in a web browser.

WebXR is the successor to webVR.

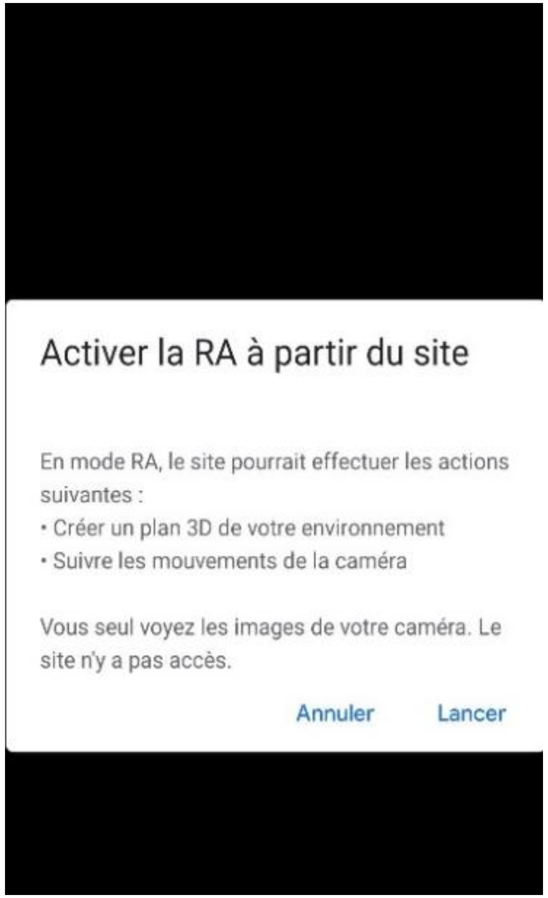
- Hybrid tracking mechanism
- Inside-out tracking
- Marker less method
- Computation outsourcing approach

Prototype

Device: Samsung Galaxy A7(2018)



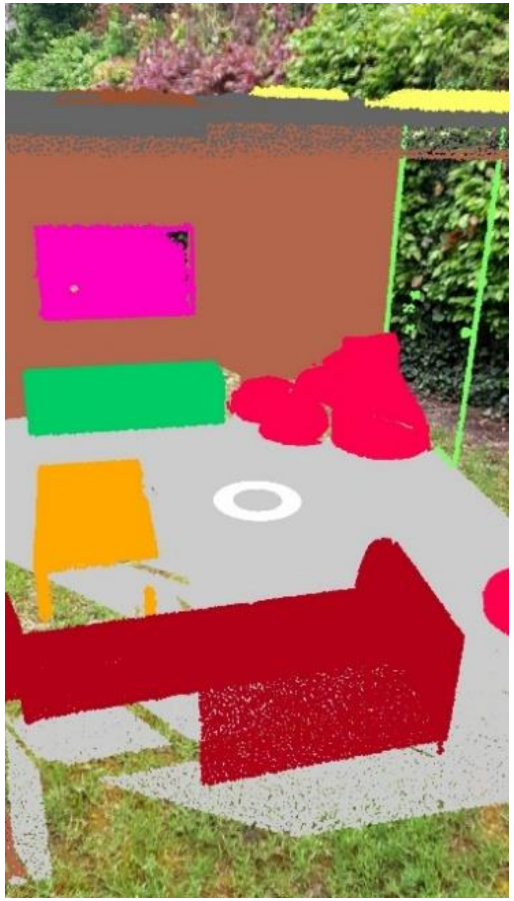
Results and discussions



(a) Creation of augmented reality session

(b) Hit-test to choose the anchor point

(c) Point cloud displayed in real color



(d) Point cloud displayed in classes color

Results and discussions

The results gives research directions concerning the dependence and delay related to the quality of the **network connection**, and the **battery consumption** since device sensors are used all the time.

Mobile	Exploitation system	Navigator version	RAM	Battery Capacity
Samsung Galaxy A7(2018)	Android 9	Chrome/Mozilla	4Go	3300mAh

Table 1. Technical characteristic of the device used

Challenges :

- Computational efficiency of browsers
- Networking
- Energy efficiency

Future works

- User Interface for querying and interaction (UI)
- 5G connectivity (mainly depends on 5G coverage)
- Annotation and real-world alignment tools
- Support more spatial format (BIM, CAD, LiDAR, photogrammetry and GIS)
- Measurement tools

THANK YOU FOR YOUR ATTENTION

LIÈGE université
Geomatics

Geomatics Unit | geomatics.ulg.ac.be

Allée du Six Août 19 (B5A) | 4000 Liège

akharroubi@student.uliege.be

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Acknowledgements

The authors are thankful to the developers of CloudCompare, Potree, Three.js and WebXR API. We also thank a lot the users of the Github forum, especially the authors of three.js that helped us in several steps of this research.