VC Project

Image Inpainting with Aruco Markers

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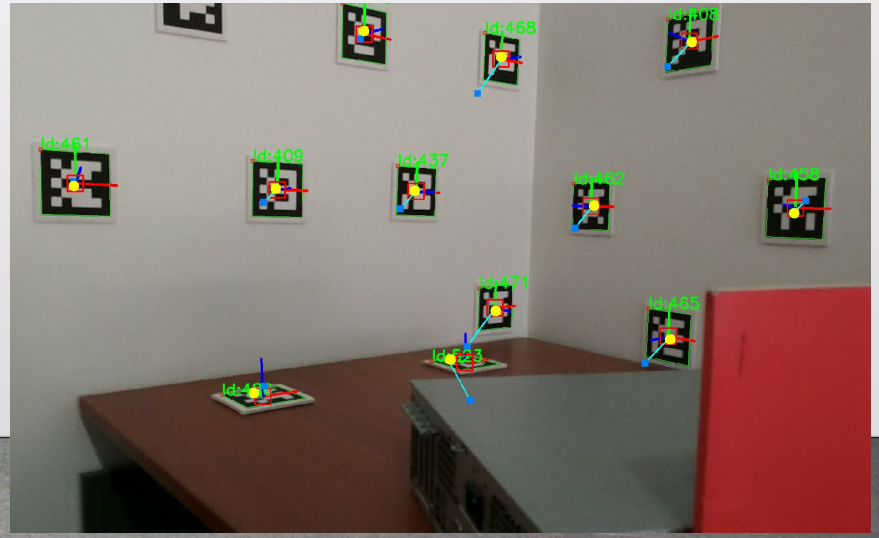
Scope

- Master's thesis in geometric optimization for 3D reconstruction (indoor env.)
  - Using a series of pictures of the scene (Bundle adjustment):
    - Simultaneously refine the 3D coordinates describing the scene geometry and the optical characteristics of the cameras
  - Involves the use of ArUco markers to:
    - Make a first guess
    - Define the ground truth



Motivation

- Markers are **necessary**!

  ...But won't look great in the final product!

Can we **remove** them?

- The **points clouds** will be used to

  understand and measure the effect of the optimisation and its **success**

The outline

- **ArUco** detection
- **Inpainting**
- **Improved inpainting**
- **Cross inpainting**

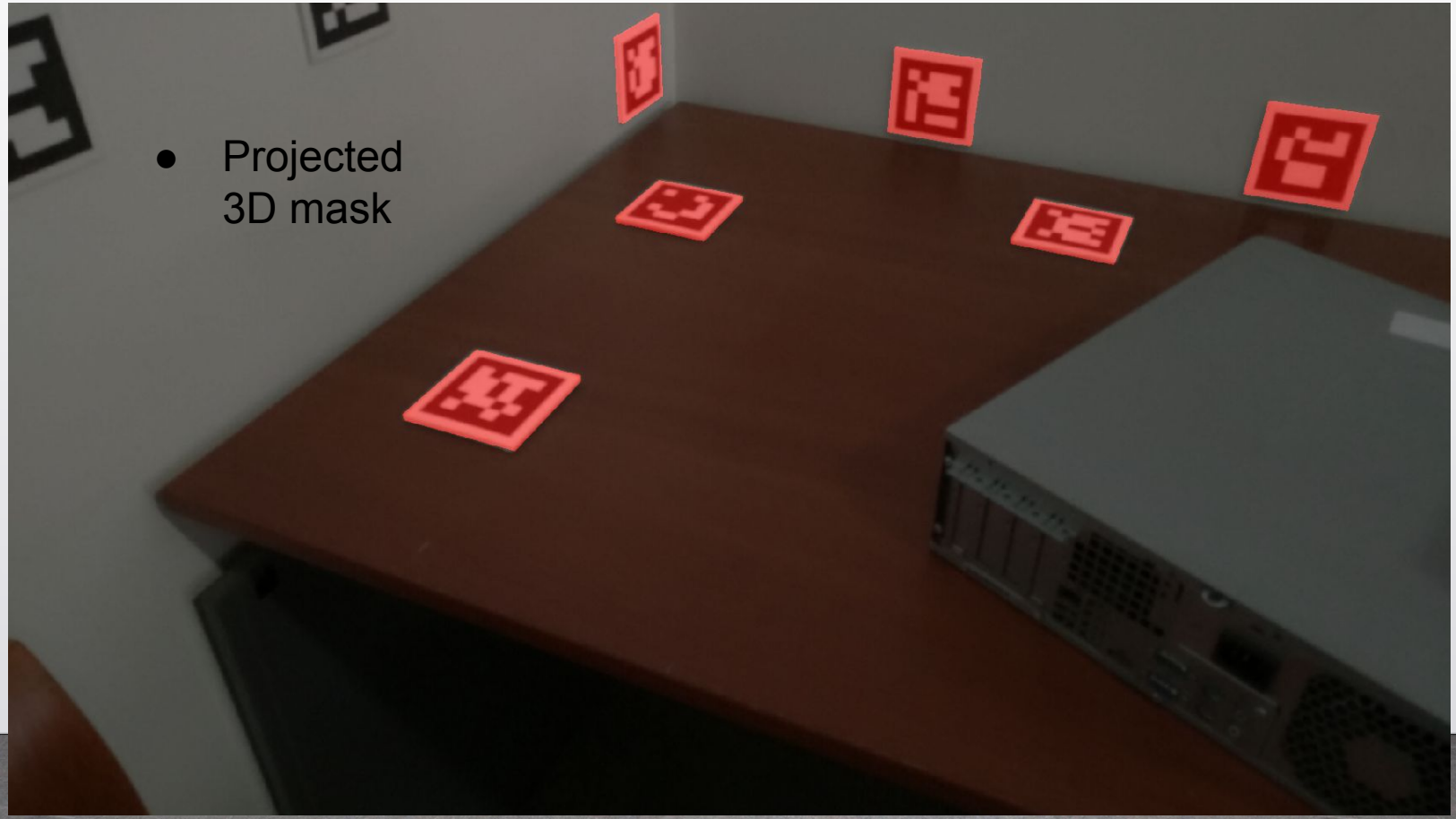
- **Point cloud** (.ply) coloring
- **3D Showcasing**
  - Combined clouds

(Bridge to the use of inpainting in thesis)

Simple Inpainting

- Dataset loading with standard tools
  - Developed with Professor Miguel Oliveira
- ArUco detection and display
- Inpainting

Inpainting mask

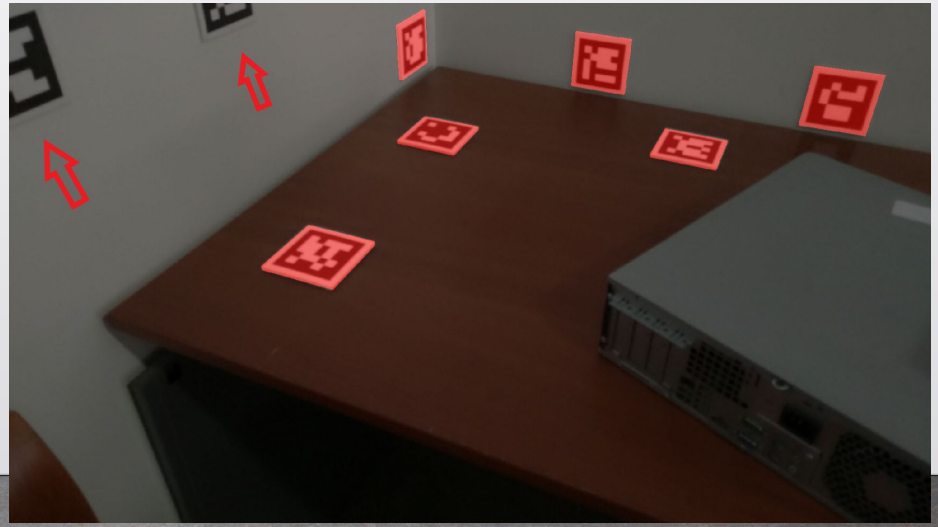


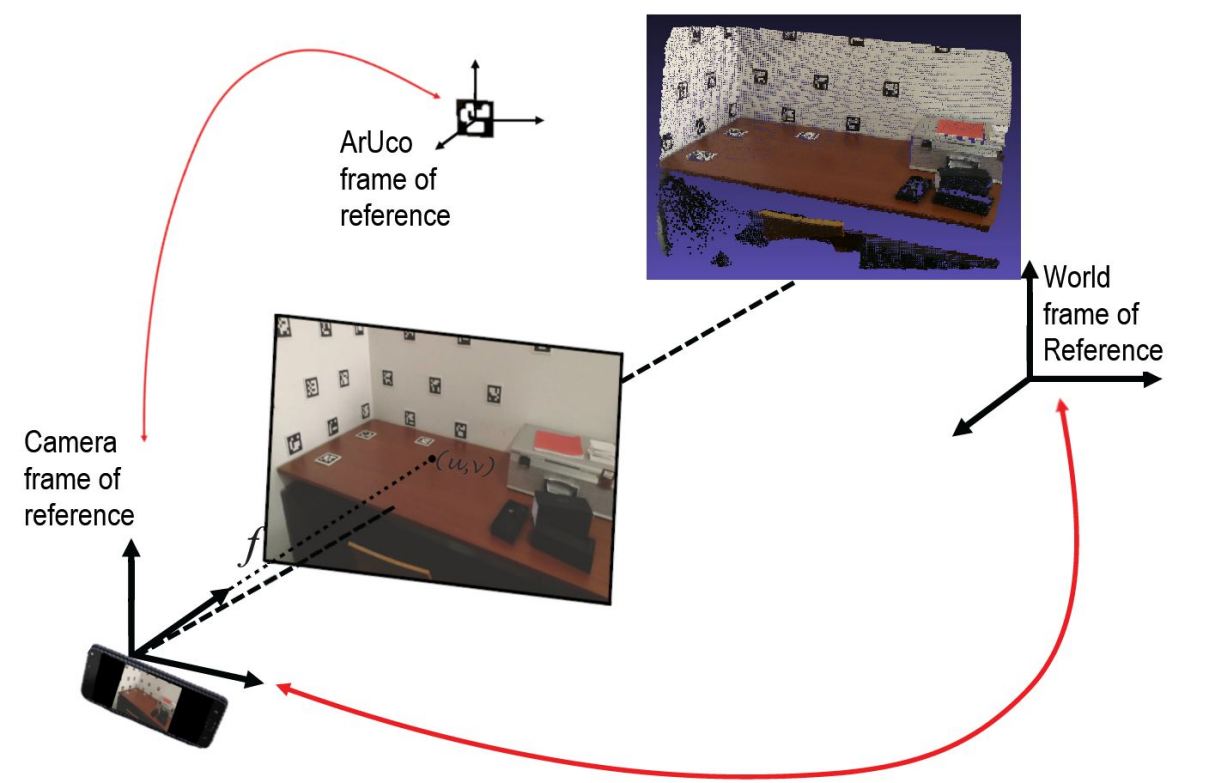
Inpainting mask creation

- Final inpainting masks:
  - Creation of 3D object in ArUco coordinate system
  - Projection to image

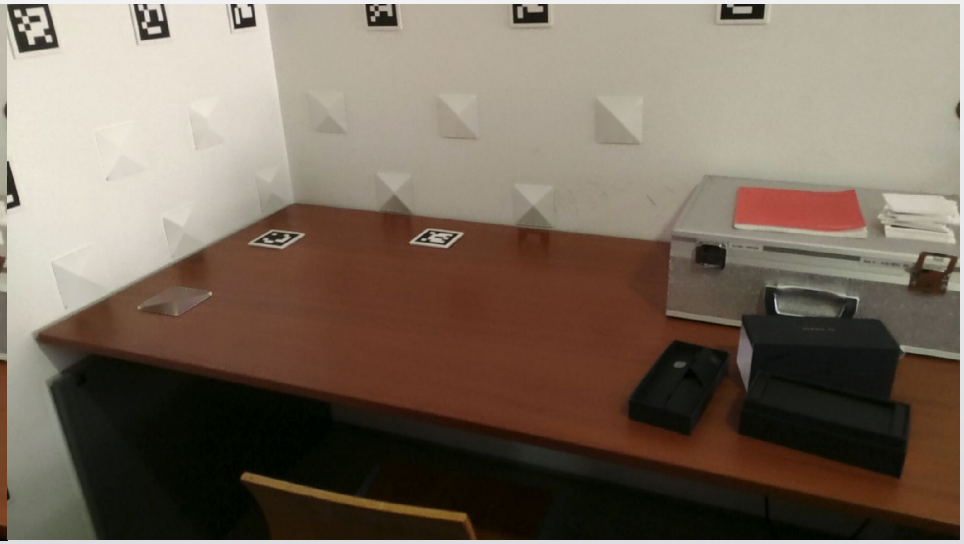
Why?

- ArUco borders and perspective
- Inpainting undetected markers(?)



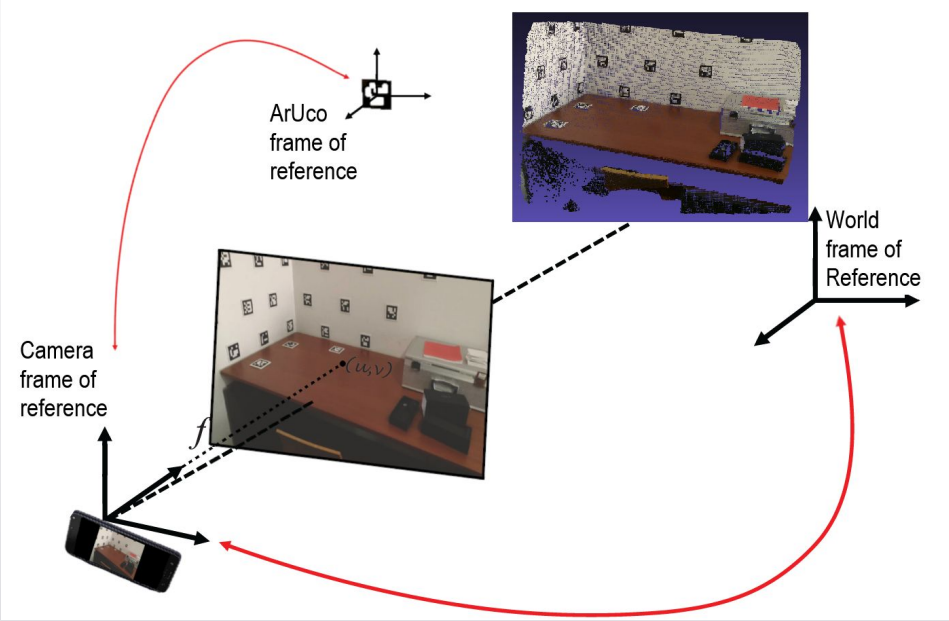

ArUco
frame of
reference
World
frame of
Reference
Camera
frame of
reference
(u,v)
f

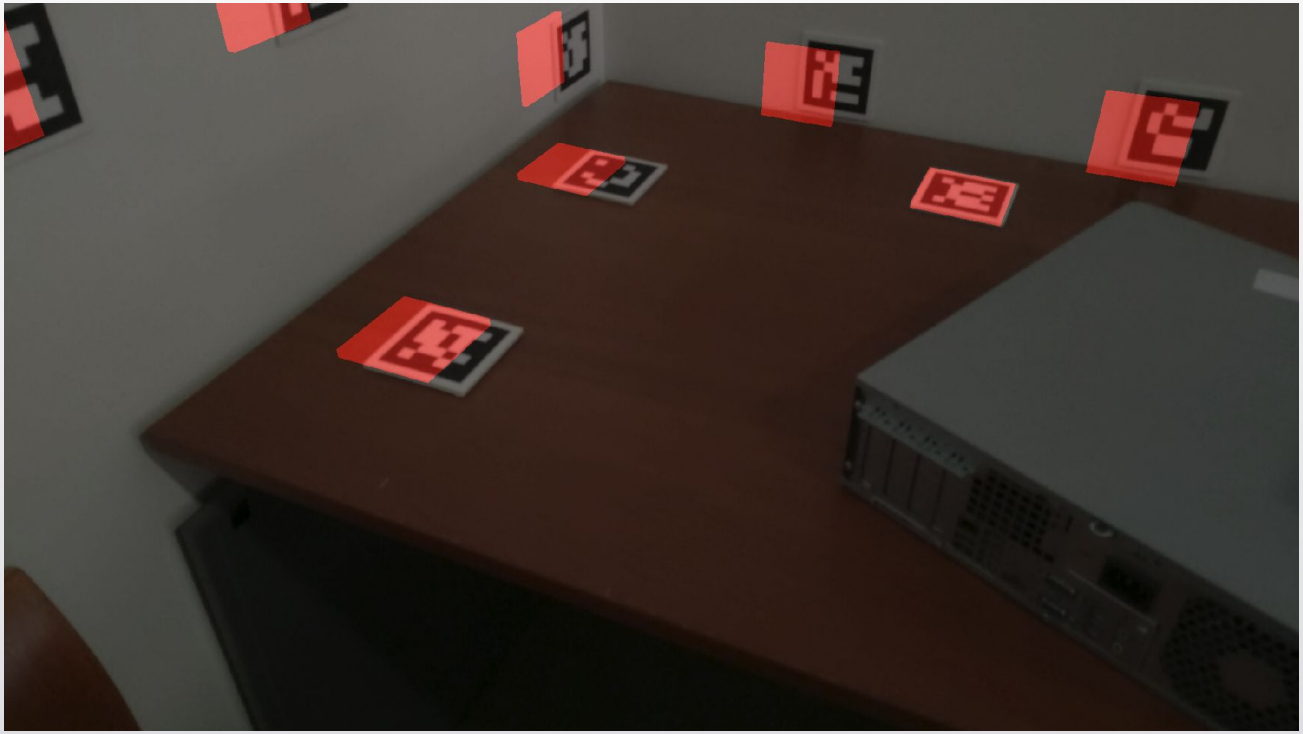
Improving inpainting



Cross inpainting

- When new ArUco marker is detected
  - **ArUco to world** transformation is calculated and saved
- When inpainting image, for all ArUcos
  - **ArUco to world** through other camera
  - **World to this camera**
  - Check projection to image



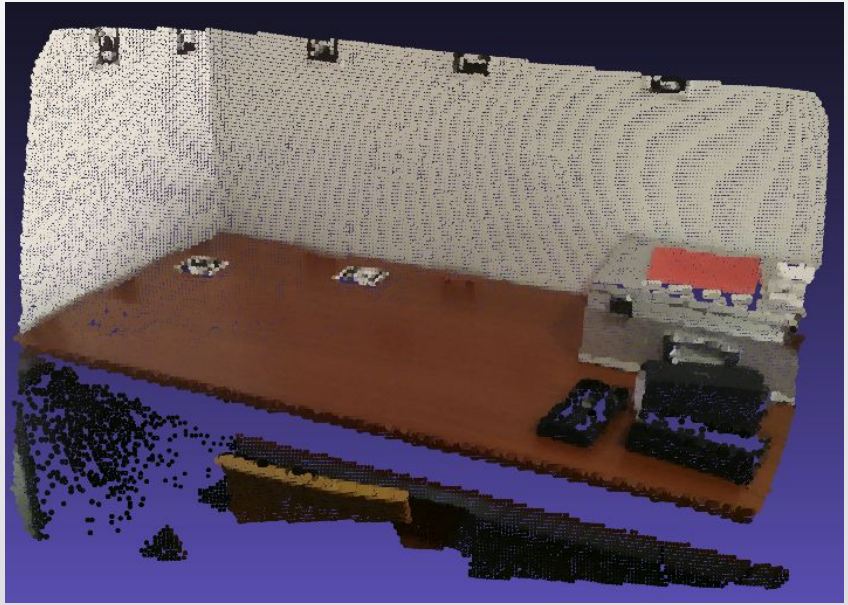


“Cross-Inpainting”

- The **projections work**
- However the **error** associated doesn’t allow **inpainting**
- Expected to work well after optimization

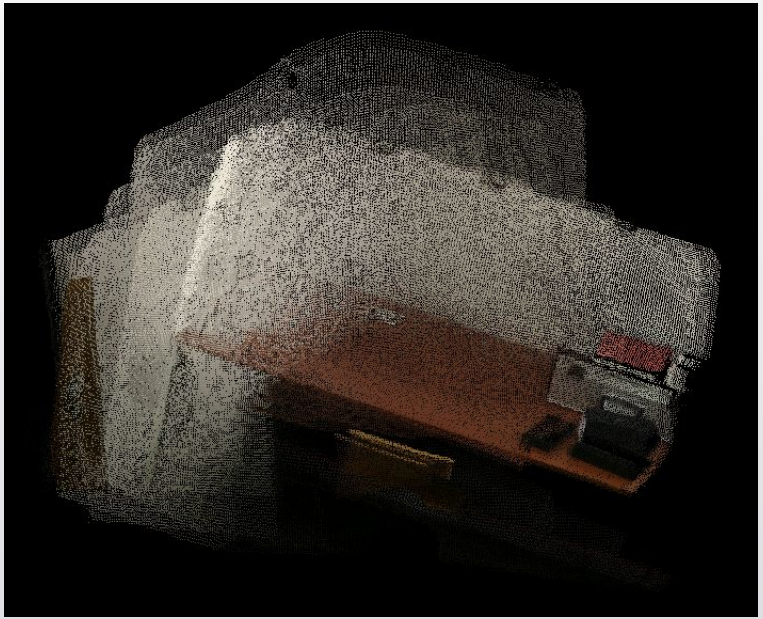
Coloured point clouds

- **Read** .ply file
- Coordinates **OpenGL** to **OpenCV**
- **World to camera** transformation
- **Project** in image
- Extract **RGB value**
- **Write** .ply file



Point cloud combination

- Demonstration purposes
- ICP algorithm
- Chain alignment
- Concatenated display



Conclusion

- The goals set for the project were achieved
- Successful creation of tool useful to improve the visual aspect of texture
- Visualisation of the textures in the point clouds
- The features developed can be used in other contexts

  (AR for example)