AR App Development:
Pelvic Tumor Resection Guidance

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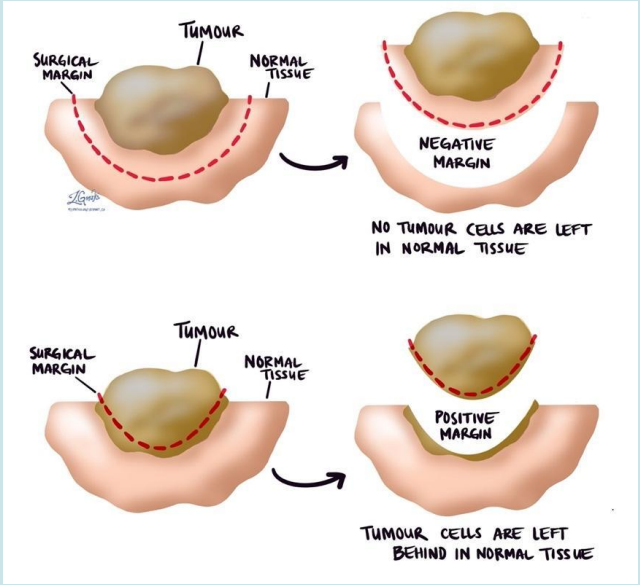
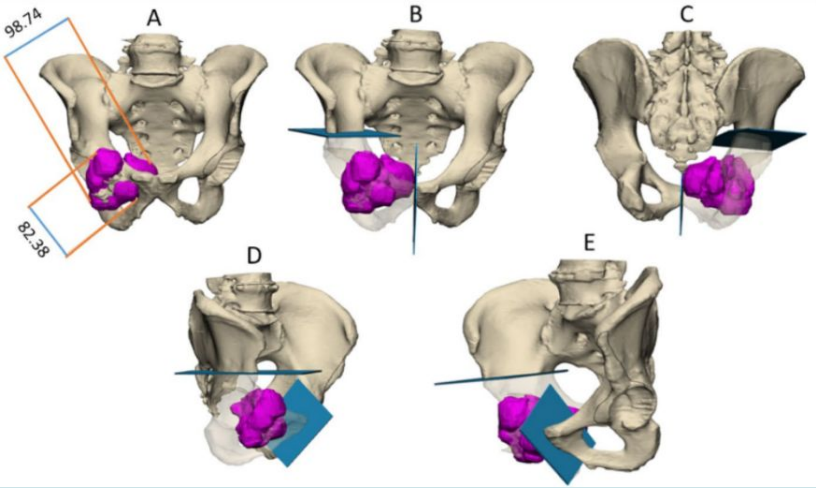
INTRODUCTION

BACKGROUND

Pelvic tumors pose significant challenges in surgical management due to their complex anatomical location and potential for aggressive growth.



INTRODUCTION



IMPORTANCE

Given the complexities associated with pelvic sarcomas and the challenges in achieving optimal resection margins while preserving limb function, tools such as AR technology can revolutionize surgical planning and execution.

OBJECTIVES

The objective of our project is to **develop an AR application** capable of calculating optimal margins and projecting the tumor along with its safety resection boundaries in real-time during surgery.

The aim is to provide the surgeon with a **visual and practical tool** that:

- ❑ Facilitates precise tumor resection
- ❑ Minimizes damage to surrounding structures
- ❑ Improves surgical and oncological outcomes for patients

SPECIFIC OBJECTIVES

Several key steps had to be considered for the accomplishment of the project.

This includes:

- Design and 3D printing of a **surgical guide** for attachment to the pelvic region.
- Definition of a **AR-based marker** for our application.
- Development of a **AR application for tumor visualization** on top of the pelvis.
- Added **functionalities** for clinical environment simulation.
  - Ability to customize for different patients and tumor types.
  - Option to show the optimal approach for resection.
  - Toggle options to show/hide the pelvic bone and tumor.
  - Option to display the coronal cross-section of the tumor.

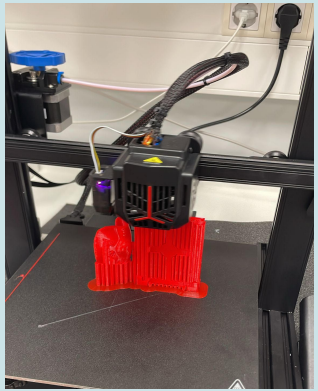
ROADMAP

DESIGN & PRINTING OF SURGICAL GUIDE

MARKER DEFINITION

AR APP DEVELOPMENT

ADDED FUNCTIONALITIES



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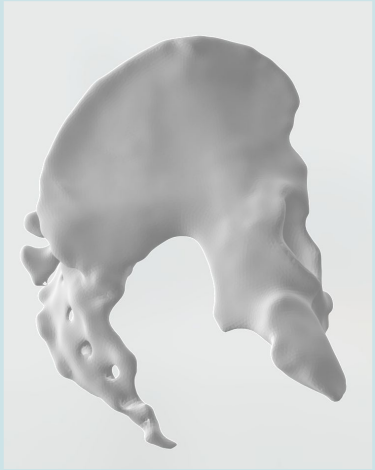
PELVIS MODEL

Model Utilized: Pelvis 3D printed Phantom

- Lent to us by the UC3M lab
- Guide attached to it
- Accurately replicate the anatomical structure of the human pelvis in the app

Virtual model:

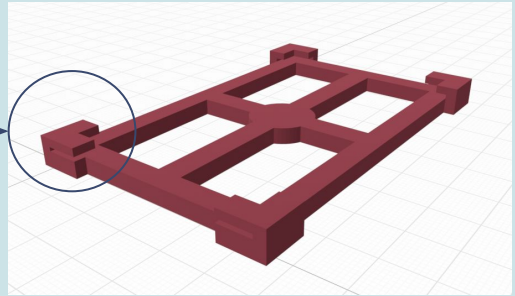


Physical model:

SURGICAL GUIDE DESIGN

- Design **surgical guide** to attach to pelvis bone.
- Design **card holder** for AR marker.

Added side slot to introduce the card



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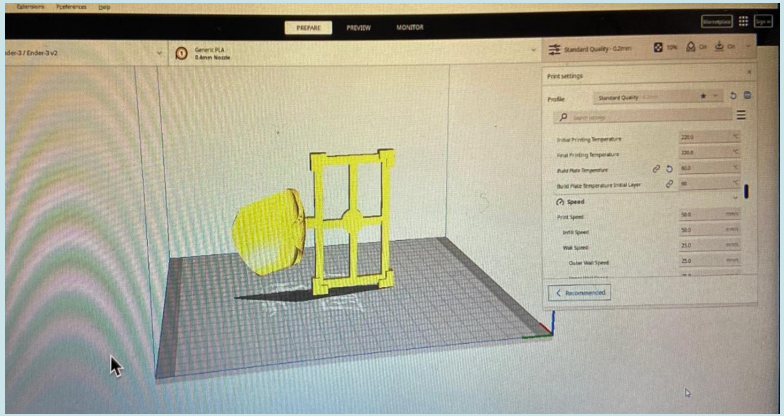
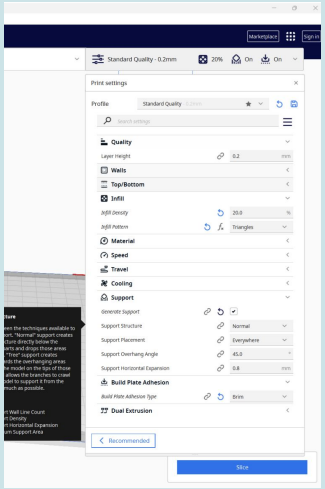
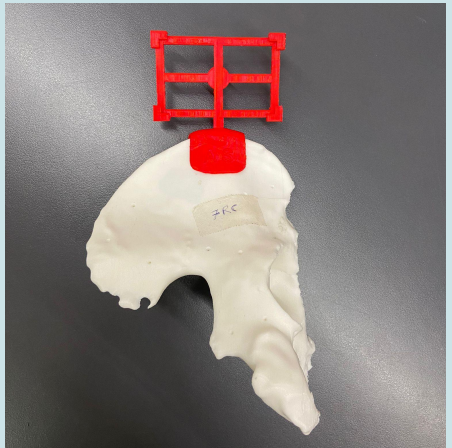
SURGICAL GUIDE DESIGN

- 3D print the combined model.
- Several tries
- Solution: changing printing parameters
  - Support structure to **Normal**
  - Build plate temperature to **60º**
  - Infill density to **10%**

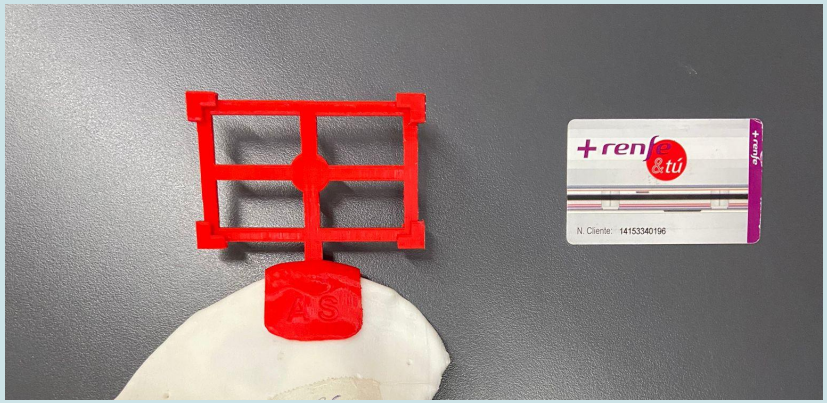






MARKER DEFINITION

- Software: **vuforia**
- Requirement: universal marker
  - No personal identification
  - Easily identifiable by app
  - Available everywhere



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PelviAR DEVELOPMENT

Main part of the project

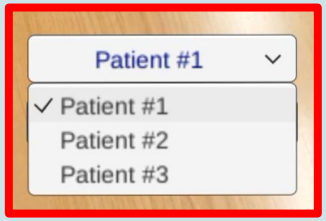
Software: **Unity** & VSCode → 7 C# scripts

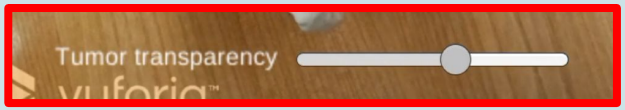
Design requirements:

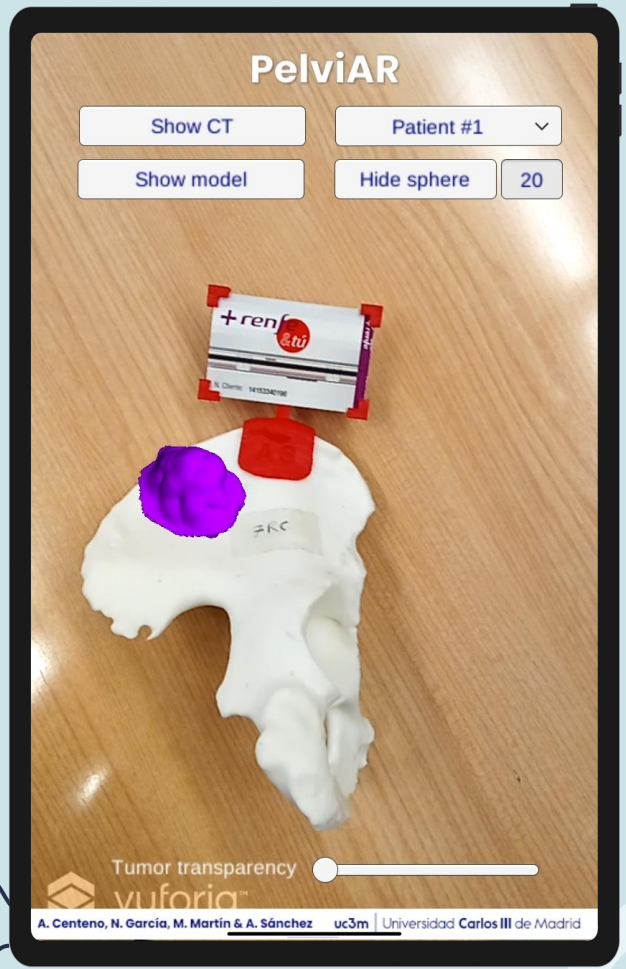
1. Practical and **user-friendly** interface
2. Aid surgeons **prior** the operation
3. Visualize **resection margins** on patient

PelviAR FEATURES

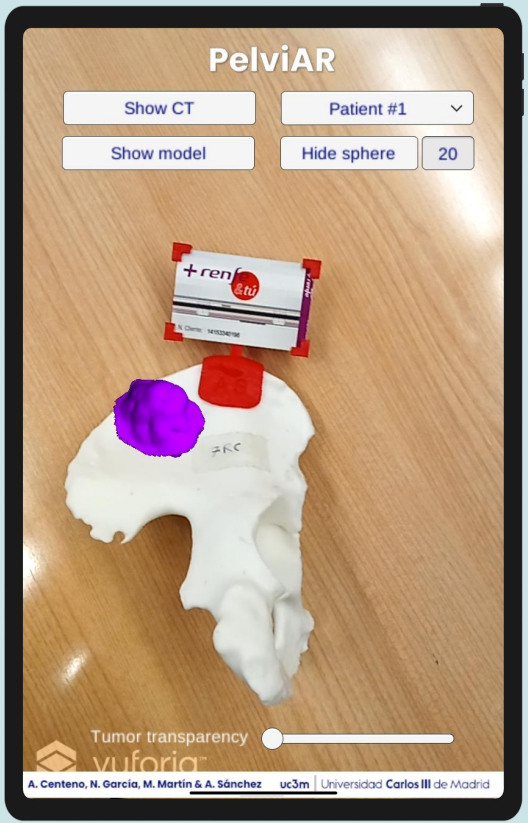
- Dropdown for **patient selection**
- Slider for tumor **transparency**
- Button for superposition of real and **virtual model**



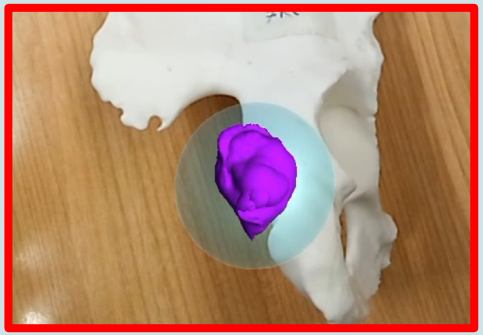




PelviAR FEATURES



- Button for **anatomical CT image**
- Calculation of **sphere boundary**
- **Input field** for personalized margin



unity

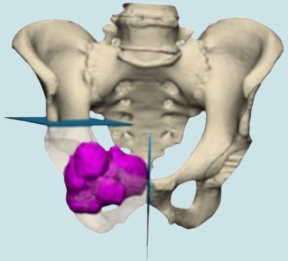
LIMITATIONS

Lack of database

iOS implementation

LIMITATIONS

Margins projections



Tumor location

Rudimentary margin calculation

FUTURE LINES

Solve limitations

- ❏ Accurate projection of margins and tumor
- ❏ Real 3D model from a CT.
- ❏ IOS implementation.

Advanced calculation margins algorithm

- ❏ Consider tumor size, severity and location
- ❏ Consider nearby structures (vascularization)

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Validation Method

- ❏ Tracking systems: evaluate the effectiveness of the app

CONCLUSION

FIRST STEP

APP

- Visualization
- Optimal margins calculation

IMPROVE PATIENT'S RECOVERY

Aids in the obtention of negative margins that have a positive impact on patient's recovery

THANKS

DO YOU HAVE ANY QUESTIONS?

PelviAR DEMO