UNIVERSITY OF
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Computer Vision and AR for Endovascular Intervention

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Contents

Abstract

This section should contain a concise summary of the document content.

Statement of Ethical Compliance

Data Category: A
Participant Category: 0
I confirm that I have read the ethical guidelines and will follow them during this project. Further details can be found in the relevant sections of this proposal.

1 Introduction & Background

2 Design & Implementation

2.1 Part1: Real-world Model Interaction and Tracking

In this part, I used OpenCV[1] and SciKit-Surgery Augmented Reality[2] libraries for image processing and model tracking, while QT[3] is used to design the graphical interface. OpenCV and SciKit-Surgery help in processing images and tracking ArUco Markers[4] within these images, essential for enhancing interaction between virtual and real-world elements. QT allows me to create a user-friendly interface, ensuring that the system is accessible and manageable for users with different levels of technical expertise. This section will detail the system's architecture and functionality, focusing on System Components and Organization, Data Structures and Algorithms, User Interface Design, and Design Notation and Diagrams.

2.1.1 Design

1. **System Components and Organization**
2. **Data Structures and Algorithms**
   (a) **Frame Storage**
   (b) **Feature Data Structures**
   (c) **Image Processing Algorithms**
   (d) **Marker Detection and Tracking**
   (e) **Model Positioning and Rendering**
   (f) **Optimization Techniques**
   (g) **Algorithm Efficiency and Complexity**
3. **User Interface Design**
   (a) **Screen Mockups, Sketches, and Screenshots**
   (b) **OpenCV-Based Real-world Interaction Component**
   (c) **ArUco Marker Detection and Model Positioning**
4. **Design Notation and Diagrams**
   (a) **Use Case Diagrams**
   (b) **Interaction Diagrams and Class Diagrams**
   (c) **Pseudocode and Data Flow Diagrams**

References

[1] G. Bradski, "The OpenCV Library," *Dr. Dobb's Journal of Software Tools*, 2000.

[2] S. Thompson, T. Dowrick, M. Ahmad, *et al.*, "SciKit-Surgery: Compact Libraries for Surgical Navigation," *International journal of computer assisted radiology and surgery*, vol. 15, no. 7, pp. 1075–1084, 2020. DOI: 10.1007/s11548-020-02180-5.

[3] The Qt Company, *Qt - cross-platform software development for embedded and desktop*, [Online; accessed 29-April-2024], 2024. [Online]. Available: https://www.qt.io.

[4] M. Fiala, "Artag, a fiducial marker system using digital techniques," in *2005 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'05)*, vol. 2, 2005, 590–596 vol. 2. DOI: 10.1109/CVPR.2005.74.