

Product Name: RePoste

Client: Terry Yoo

Team Name: Goobernauts

Team Member Names:

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RePoste Fencing Replay System
User Interface Design Document

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1. Introduction

This capstone project is for the development of a video replay software system for the sport of fencing. This project is for Dr. Terry Yoo, in partial fulfillment of the Computer Science BS degree for the University of Maine. Our team will also be working closely with the University of Maine's fencing club, the Blade Society, when developing this product.

The goal of this project is to create open-source video replay software that can run on a laptop using MacOS or Windows. The USA National Fencing requires a video replay system to help referees review calls during fencing matches. Currently the replay system used is outdated, expensive, closed-sourced and needs to be updated. This product aims to give a solution to clubs and competitions by offering an open-source solution that can increase accessibility to video replay systems.

1.1 Purpose of This Document

The purpose of this UIDD document is to provide a guide for the user interface design choices for the replay system. The document covers the user interface standards, user walkthrough of the interface, and data validation. It also includes accessibilities and inclusive design explanations, diagrams detailing screen navigation, button functionality, and data validation. The document is meant to serve as a resource for stakeholders and development

1.2 References

This section includes citations to project documentation and other sources that were used to develop the project's design and interface thus far. PyQt6 and ImageIO are Python libraries used to handle UI construction and video feed playback respectively. The use of these libraries are the result of testing the functionality of OpenCV. The team chose to go forward with ImageIO for video functionalities over OpenCV; the reason being we encountered issues with video playback speeds when using the OpenCV library. Super Fencing System is an accessible and mobile iOS application that produces the replay abilities we hope RePoste to have as a completed project. The final two references are design guides related to color and its use in web and application design, and user accessibility and inclusive design.

1. **Proposal:**

Yoo, Terry (2024). "Video Referee Replay System Software for Sport Fencing Competition" Project Proposal, University of Maine.

2. **SRS:**

RePoste System Requirements Document (Version 1.0), Goobernauts, 2024

3. **SDD:**

RePoste System Design Document (Version 1.0), Goobernauts, 2024

Knowledge Acquisition:

1. GitHub. (n.d.). CMake quality GitHub action. <https://github.com/marketplace/actions/cmake-quality>
2. Imageio. (n.d.). Imageio(2.36.1). <https://pypi.org/project/imageio/>
3. Kitware, Inc. (n.d.). Documentation overview. CMake. <https://cmake.org/documentation/>
4. Kitware, Inc. (n.d.). Mastering CMake. CMake <https://cmake.org/cmake/help/book/mastering-cmake/>
5. Kitware, Inc. (n.d.). Welcome to CMake. CMake. <https://cmake.org/>
6. OpenCV. (n.d.). OpenCV: Open source computer vision library. <https://opencv.org/>
7. Riverbank Computing.(n.d.). PyQt6(6.7.1). <https://pypi.org/project/PyQt6/>
8. U.S. General Services Administration. (n.d.). Color overview: Design tokens. U.S. Web Design System. <https://designsystem.digital.gov/design-tokens/color/overview/>
9. U.S. General Services Administration. (n.d.). UX design: Accessibility for Teams. <https://digital.gov/guides/accessibility-for-teams/ux-design/#content-start>

Client Supplied:

1. Super Fencing System. (n.d.). Welcome to Super Fencing System. <https://superfencingsystem.com/>
2. Koov Broadcasting. (n.d.). Referee video replay user manual. <http://escrime.koovbroadcasting.com/download/RefereeVideoReplayUserManual.pdf>
3. Fédération Internationale d'Escrime. (n.d.). Handbook of specifications for video refereeing. https://static.fie.org/uploads/3/18851-Handbook_of_specification_Video%20Refereeing.pdf
4. Super Fencing System. (n.d.). SFS-Link manual (Version 1.1). https://superfencingsystem.com/SFS-Link_Manual_V1.1.pdf

2. User Interface Standards

Our user interface standards section is going to remain simple and provide the referees with an easy to follow video replay system UI. We will do this through making use of the keyboard, buttons, sliders, and arrows with text that will help make sure referees understand the controls. This section will ensure that interface design standards are being met throughout the RePoste system.



For the first menu, the following standards should be followed.

Layout:

- The UI should remain in the following format.
 - There will be space on the left to have the buttons needed to turn the camera on and off, record the playback, and be redirected to the replay menu through the Replay Footage button.
 - If more buttons are included on the left side, ensure that a scroll feature is implemented where a user can scroll to desired function.
 - The buttons are color coded to have some form of recognition between the functions
 - Green: Camera On
 - Red: Camera Off
 - Blue: Playback recording functions
 - Orange: Replay Footage menu.
 - Center of the screen is the video display.
 - Once the Camera On button is clicked, the middle of the screen should show the camera being used to record the fencing competition.
 - The top of the layout is reserved for the file directory the playbacks are being sent to.
 - On this bar there is a folder icon to choose the desired footage storage location.
 - The save button ensures that all recordings are being saved into the users wished location.
 - Underneath the camera player should be left for features like sliders.
 - Currently in this section is a Playback Duration slider that changes how much playback is being recorded

Color:

- The color scheme will be relatively simple. Keeping a plain gray background will help maintain a professional look without having too many distracting colors.
- Buttons should have vibrant colors to show that they are clear to be used and used for functions

Text:

- The text should remain simple and be readable for users. This includes:
 - Having the text remains large.
 - Have the text remain as a simple font to ensure readability.
 - Mark features like sliders, arrows, and buttons.



For the second menu the format stays relatively the same. The middle for the replay footage, the left and bottom for any features relating to the video playback. The top for directory location/what video is being pulled up.

- For this menu some things will be added. Such as a menu to pull up clips that are saved inside of the directory.
- Section left of the replay footage contains replay functions.
 - First there is the video playback speed represented by the + and - arrows with text between them stating the percent speed.
 - Underneath that, we have the audio control for the video.
- Bottom left section has the controls for video playback.
 - The play/pause buttons are represented by arrows for skipping and replaying the clips.
 - Buttons to replay the clips by 1 second either forward or backwards.
- Top bar has a Return button to bring the users back to the first menu.

2.1 Accessibility and Inclusive Design Elements

Accessibility features will be handled primarily by stylings in the UI. The main focus to start will be ADA compliant colors in our design to be inclusive for users with visual disabilities. This means avoiding color combinations that might hinder people with colorblindness from operating the system. Another focus will be on ensuring the design is compatible with cognitive disabilities like dyslexia. We plan to use appropriate sans serif font styles and proper color contrast to accommodate these users. When accommodating users with hearing impairments, the system will have a feature to toggle on/off the audio recording. Accommodations for users with motor impairments will be full keyboard navigation and clear visual cues. Stretch goals could include accessibility features like fencer pose detection to start video recording and controller support.

This would limit the amount of interactions that the video referee would need to have with the system if they are dealing with limited dexterity.

Vision disabilities: Color Blindness

- Use color ADA compliant color combinations
- Black and White

Cognitive disabilities: Dyslexia

- Utilize sans serif typeface
- Implement proper color contrast

Hearing disabilities: Deafness, low-hearing

- Toggle audio
- Visual Cues

Motor problems: Loss of limb permanently, temporarily, or situationally.

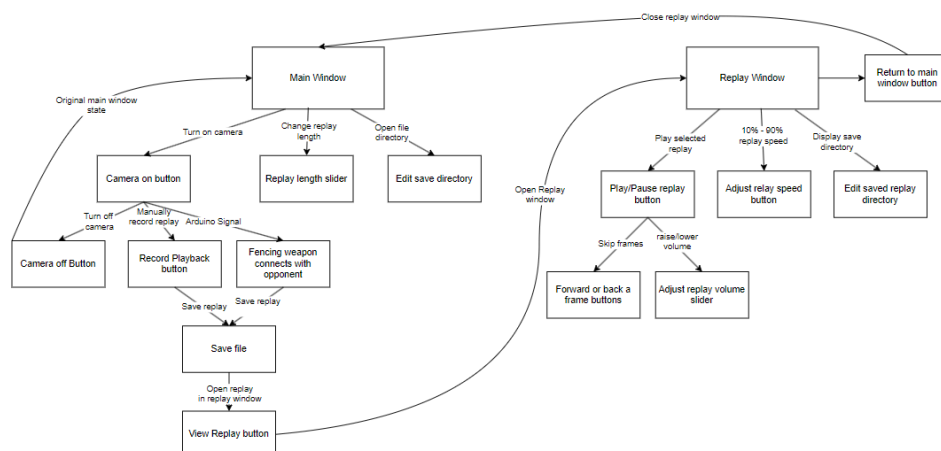
- Full keyboard navigation

3. User Interface Walkthrough

This section contains our walkthrough for the User Interface, below are diagrams for user navigation and a key containing symbol meanings. There are additional screenshots of all system screens numbered, labeled, with explanations for what the user is seeing, menus, functions, and navigation instructions.

Navigation Diagram:



The navigation diagram represents a walkthrough of what each button or slider will do and how they will interact with each other within the RePoste application. It displays how the Main Window and Replay Window will act during different phases of the program and how the user/referee will use the interface to save and use replays. This involves saving replays by using the UI or by interaction with the Arduino when a fencer scores a point or hits a foul.





Menu:

- **Camera On** (Figure 1)
 - The Camera On button will turn your camera on within the viewing window.
- **Camera Off** (Figure 2)
 - The Camera Off Button turns off your camera and gets rid of the display in the viewing window.
- **Record Playback** (Figure 3)
 - The Record Playback button will record how many seconds you have set in the Playback Duration slider.
- **Replay Footage** (Figure 4)
 - The Replay Footage button brings you to the second menu where you can replay the footage you have saved using the Record Playback button.
- **Playback Duration: 5 Seconds** (Figure 5)

- The Playback Duration slider is used to set your playback duration, currently we have it set to 1-10 seconds of recording.
-  (Figure 6)
 - The Folder button is for opening and setting the directory you wish for your replays to be stored in.
-  (Figure 7)
 - The Save button ensures that all footage is being saved to the directory.



- (Figure 8)
 - Play/Pause button for video replay. The left and right arrows are for starting at the beginning or end of the clip. Triggered by the Spacebar



- (Figure 9)
 - Replay playback button which can adjust the video speed of the replay ranging from 10% - 90%. Handled by the 1-9 keys on the keyboard.



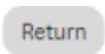
- (Figure 10)
 - Skip frame button allows the user to skip forward or backward one frame at a time. Handled by the left and right arrow buttons



- (Figure 11)
 - Volume slider to adjust volume levels of video replay



- (Figure 12)
 - The Folder button is for displaying the file directory that the replay will be saved to.



- (Figure 13)
 - Return button to leave the replay window. “Return” is a temporary name.

4. Data Validation

This section contains a description of data items that the system accepts from the user, the definition is broken down into the basic data type, limitations, and allowed formats the system accepts.

Name	Data Type	Limitation	Format
Video File	MP4	Must be MP4, if error reject and reprompt	MP4
Frame Image	NumPy Array	If values are missing, default color values to (0,0,0)	Dependent on Camera
Arduino Signal [ESP32] (Planned)	Boolean	Must be true or false, if error default to false	True/False
Video File Name (Planned)	String	Must follow OS naming limits, if error reject name and reprompt	videofilename.mp4
Save Location (Planned)	String	Must be a valid location, if error reject location and reprompt	C:\Users\Username\...

Appendix A – Agreement Between Customer and Contractor

This agreement confirms that the customer and the development team have reviewed and approved the contents of this User Interface Design Document (UIDD). By signing this document, both parties agree to the project scope, specifications, and responsibilities as outlined. The team commits to delivering the software according to the requirements, timeline, and quality standards defined. The customer commits to supporting the team by providing necessary feedback and resources in a timely manner.

In the event that future changes to the document are required, both the customer and the development team agree to follow a structured change management process. This process will include documenting proposed changes, assessing their impact on the project timeline and resources, and obtaining mutual written consent from both parties before any adjustments are made to the original agreement.

Team Member Name	Signature	Date	Comments
Stephen Goodridge	Stephen Goodridge	11/13/2024	
David Geng	David Geng	11/13/2024	
Heath Miller	Heath Miller	11/13/2024	
Ryan Giles	Ryan Giles	11/13/2024	
Logan Geiser	Logan Geiser	11/13/2024	

Client Name	Signature	Date	Comments
Terry Yoo			

Appendix B – Team Review Sign-off

All members of the team have thoroughly reviewed this User Interface Design Document (UIDD) and agree on its content and format. Each team member has provided their signature and the date below as a confirmation of their agreement. The comment area is available for any minor points that team members may want to note. There are no major points of contention, and all team members are aligned with the approach outlined in this document.

Team Member Name	Signature	Date	Comments
Stephen Goodridge	Stephen Goodridge	11/13/2024	
David Geng	David Geng	11/13/2024	
Heath Miller	Heath Miller	11/13/2024	
Ryan Giles	Ryan Giles	11/13/2024	
Logan Geiser	Logan Geiser	11/13/2024	

Appendix C – Document Contributions

Stephen: Section 2, Section 3

David: Section 1, Section 4

Heath: Section 1.2, Section 2.1, Sister Team Feedback corrections

Ryan: Section 1, Appendices, Spelling/Grammar/Formatting

Logan: Section 2, Section 3