

# MERID - Creativity in Orchestras: FINAL Report

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## Introduction

[MERID](#) (Media Enabled Research Interface and Database) is a web application that will enable researchers to run surveys and research investigations with participants online. Note that there are two primary users of the system - researchers and participants. It is media enabled, so participants will primarily be commenting on and annotating on video/audio added by researchers, per researchers' surveys. **Our team was responsible for extending this system by enhancing the media components, video and audio, for the application. Our responsibilities span the following user tasks and specifications:**

- Researcher uploads videos and audio files
- Researcher can create multiple video group segments from one upload of video/audio files
- Researcher annotates videos (title/description) and creates video collections
- Videos and audio get synchronized via the media player
- Researcher constructs a survey based on a video collection <sup>1</sup>
- Researcher invites participants via email that the survey is available to respond to <sup>1</sup>
- Participants each respond to the survey by submitting one or many comments
- Researcher visualizes participant data responses collated with the video collection

MERID v1 was in production, while v2 was still in development when we began working on this project. Our work extended v2 and was completed on December 13, 2015. The website and

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<sup>1</sup> This feature was completed in MERID v2

media files will be hosted with Amazon Web Services (AWS), utilizing its EC2, S3, and CloudFront services specifically. See Appendix B - System Design.

We had 15 weeks to complete the project. During **weeks 1-8**, we completed a feasibility study (Appendix A), documented v2, designed the system architecture for uploading and streaming, and completed user scenarios and workflows (Appendix C) in order to fully understand the legacy application and our responsibility. We also designed prototypes for our areas of responsibility and specific features and developed a proof of concept for the video/audio player, which we identified as our highest risk area. During **weeks 9 - 11**, we conducted our first round of usability testing on each prototype with musicians who play in orchestras. We also created three sub-teams in order to concentrate on three different areas in order to implement each of these three core features:

1. Researcher Video/Audio Upload (Laurence, Chen, Chenxi)
2. Survey View for Participants (Lucas, Darcy)
3. Survey View for Researchers: Participant Data/Comments (Vinita, Yuanyuan)

In **weeks 12- 15**, we iteratively developed and implemented each of the core features. We regularly met with Celine Brass, our technical liaison, and Professor Bailey to check-in and demo the application. We also documented the application (<https://github.com/clandorf/Merid-V2/tree/dev>), updated the system design (Appendix B) and user workflows (Appendix C), and conducted acceptance testing with the Client. At this point in time, the application has been successfully tested locally.<sup>2</sup> Specifically, during the final weeks of this project, our team focused on:

1. Allowing the researcher to create video group segments
  - a. Note that video group segments will create an entire video group for each segment time the researcher inputs
2. Integrating a primary audio track into the upload process and video/audio playback
3. Adding the start/end times and role to a comment
4. Completing the survey view which is now customized for a researcher and allows a researcher to sort, filter and search comments and data submitted by participants
5. Merging code, testing and fixing bugs

A review of the requirements and details follow below.

### Review of Requirements:

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<sup>2</sup> Due to time constraints and inadequate previous documentation, testing the application on the production server was limited. General details regarding how to migrate to the production server are discussed in the Future Work section.

## 1. Researcher Video/Audio Upload

Once the researcher logs in to MERID, they will navigate to the *Manage Recordings* view. *Manage recordings* allows a researcher to click *Add Video Group*, where the media upload process is located. When creating a new video group, researchers can upload audio (max 1 file) and videos (min 1 file, max 4 files), group videos and audio into a video group, and process all of them into the same total length for uploading to S3 storage.

The video/audio upload feature supports the following:

- Set the title and position of each video and audio selected by the user
- Create a group or collection of videos and audio
  - i. Set one video or audio track as primary with an offset time of 00:00:00.00 (hh:mm:ss.ff) (ff represents frames)
  - ii. Synchronize audio/videos:
    - 1. It is highly encouraged for a successful synchronization that the respective files line up together based on the high-pitch noise from a clap or a slate that can be used as a sound reference while researchers line up the offset times inside a basic movie editing software. A video tutorial will be created to demonstrate this process for researchers.
      - a. Note: No prior trimming is necessary as offset times will synchronize the application on the server. Videos can be uploaded directly to the server and offset times can be relatively accounted for.
        - However, trimming the videos and audio tracks using video editing software such as iMovie, Final Cut or Premiere Pro outside of the MERID application can be done if the researcher chooses to do so.
    - 2. By utilizing the open-sourced technology ffmpeg, video and audio files in a video group are processed to be the same length, all starting at time 00:00:00.00 (hh:mm:ss.ff) . This ensures that researchers can upload video and audio files with varying lengths and start times,. Our application will prepend and append accordingly a black video file to any video file by the exact length (to milliseconds) to fill in the gap of time between:
      - a. Current video's start time and the time for the first video to play

- b. Current video's end time and the time of the last video to end.
- Transcode videos - Transcoding is the conversion of one encoding format to another. For example, .MTS to MP4. It can be lossless, or lossy - using compression. In our system, this work is also done by ffmpeg. So the researchers are able to upload videos with different popular formats such as .wav, .mts, .avi and .mp4. These videos can all be transcoded into mp4 in the end, without quality loss.
- Add video (recordings) groups to a project and survey, even share them to other Researchers. Although this functionality is already implemented in MERID v2, it has been refactored to accommodate our modifications to the upload process.
- Create video groups based on Video Group segments. This allows the user to cut original videos and audio file into smaller segments as they want and also put each segment into a separate video group after being processed as described above.
  - i. Ex: If the 'Title' of the Video Group is *Oxford Orchestra Star Wars Rehearsal*
    1. We have the following three 'Segment Name's':
      - a. *Cantina Song*
      - b. *Empire Strikes Back*
      - c. *Main Theme*
    2. 3 Video Groups are created
      - a. *Oxford Orchestra Star Wars Rehearsal - Cantina Song*
      - b. *Oxford Orchestra Star Wars Rehearsal - Empire Strikes Back*
      - c. *Oxford Orchestra Star Wars Rehearsal - Main Theme*
  - ii. Input the original audio and video files
    1. User can select one audio file and up to 4 video files;
    2. User can also select no audio files since the system will extract the audio from a video file.
  - iii. Input the start time and end time for each Video Group Segment so the system knows which amount of time the researcher wants that segment to be
    1. The start time and end time define which segment of the original files the researcher wants for a that new segment's video group
    2. User can create up to 3 video groups one time using this feature.
  - iv. Modify all the original files according to the researcher's input and create a video group for each segment

1. All audio and video files in a video group are of the same length as required by the user
2. All video files in a video group are transcoded into .mp4 files

Figure 1: Researcher Video Upload

Add a New Video Group

Video Group

Title

Location

Date

Projects

Select a Project	Project Name	Orchestra Name	Institution
<input type="checkbox"/>	Final Final Project Test	Orchestra Test	Institution Test

Audio/Video Files

Audio File

Name	Orchestra View	Offset Time	
Audio_10_15.wav	General	00:00:00.00	<div>Choose File</div> <div>Browse...</div> <div>No file selected.</div>

Video File

Name	Orchestra View	Offset Time	
Video1_10_15	General	00:02:14.00	<div>Choose File</div> <div>Browse...</div> <div>No file selected.</div>
Video2_10_15	Conductor	00:04:19.08	<div>Choose File</div> <div>Browse...</div> <div>No file selected.</div>
Video3_10_15	Bass	00:05:29.92	<div>Choose File</div> <div>Browse...</div> <div>No file selected.</div>
Video4_10_15	Singer	00:02:14.54	<div>Choose File</div> <div>Browse...</div> <div>No file selected.</div>

Create Video Group Segment

Each segment below will create its own video group based on the start and end times. Use your primary file with the offset time of '00:00:00' as your reference for your start and end times.

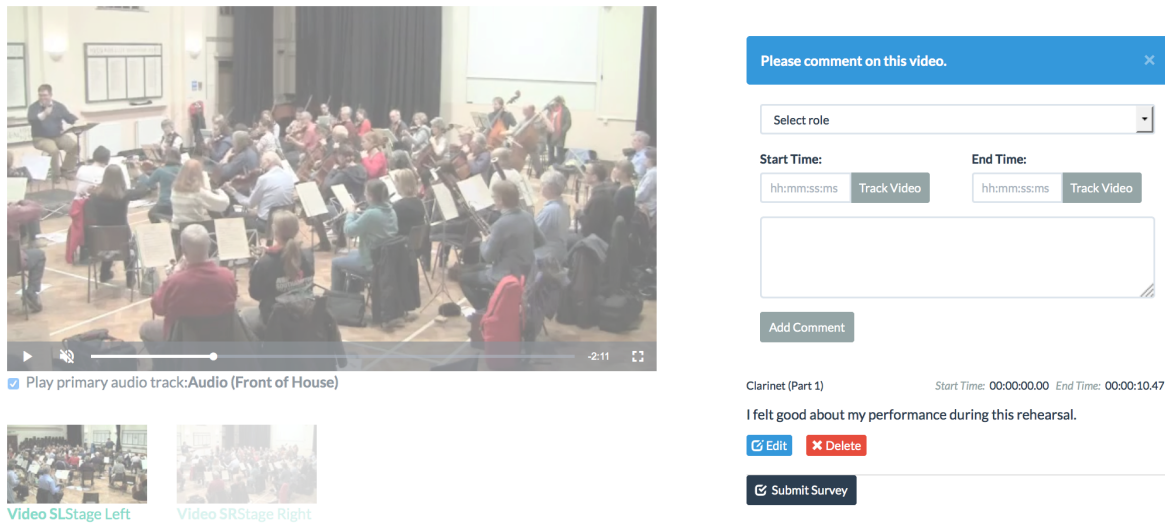
Segment Name	Start Time	End Time	Description
Cantina Theme	00:01:35	00:05:14	Star War
Cantina Theme	00:01:35	00:05:14	Star War
Cantina Theme	00:01:35	00:05:14	Star War

## 2. **Survey View for Participants** -- Synchronized video and audio playback with participant annotations

- If the participant already has an account, then they simply login and navigate to the video and audio player. Otherwise, they must first create an account. Instructions are contained within the email invitation.
- Once the participant logs in to MERID, they will navigate to the *survey* view for participants. Our responsibility for this feature focused on the view containing a synchronized video and audio player as well as participant annotation feature.
  - NOTE: The interface to support navigating between video groups within a survey is outside the scope of this project.
- Our feature supports the following:
  - View one, two or four videos, and/or listen to a separate (primary) audio track
  - Primary video player (large, center) displayed with a poster image
    - Generate poster images for all videos on page load
  - All videos displayed as thumbnails with their title and/or position
    - Generate thumbnail images for all videos on page load
  - Indicate to user which video is active by highlighting (video currently playing)
  - Switch video playing without interruption of the audio; the new video begins where the previous video left off
  - Primary audio track (determined by researcher, might be separate audio track of primary video)
  - Switch the audio track (either primary audio track or the video that's currently playing)
  - Indicate to user which audio track is active by using a checkbox on the
  - Comment on video including start time, end time, role of participant, and message
    - Set a start time one of three ways:
      - By typing a start time
      - By starting to type a new comment (which enters the current video playback time)
      - Or by clicking on a timer button (which tracks the current video playback time until timer is stopped)
    - Set an end time one of three ways:
      - By typing an end time
      - By starting to type a new comment (which tracks the current video playback time until timer is stopped)

- Or by clicking on a timer button (which tracks the current video playback time until timer is stopped)
- Enter/type a comment
- Select a role (roles are previously established by researcher)
- Submit individual comment
- Validate comment form
  - Start and end time must be in *hh:mm:ss.ms* format
  - End time must be greater than start time
  - Comment message is required
- Edit a comment and its associated start and end times or role
- Delete a comment
- Allow one to many comments to be entered
- Submit survey (all comments)
- Warn user that once a survey is submitted, it cannot be changed (*Not implemented.*)
- Privacy of participants' annotations and responses is an important consideration. Participants' comments cannot be shared with other participants, however, researchers must be able to view participants' comments. This is already built into the application, however, it is extremely important to ensure this security and privacy is not broken.
- This player with its commenting feature should be viewable and user-friendly on mobile devices as well as desktop or laptops. The application was already built in bootstrap - which is well-known and utilized responsive (adjusts to screen size) web application framework. This participant view does render differently based on screen size. For example, the video and comment form sit side by side on a screen that is at least 800 pixels wide, yet on a smaller screen, such as a phone, the comment form sits below the video player to better utilize screen space. Also, the width of the player and comment form is a percentage of the screen size, instead of an absolute value. The player renders within the percentage of screen space it's allowed and changes when the screen size is changed.





**Figure 2: Survey View for Participants (Please note: Image is purposefully dimmed for privacy.)**

3. **Survey View for Researchers** -- Visualization of participants' comments/data plus synchronized video and audio playback with participant annotation
  - a. Once the researcher logs in to MERID, they will navigate to the *survey* view for researchers. This view provides a way for researchers to search, sort and filter participant data (comments) as well as a synchronized video and audio player and a supporting annotation feature is our team's responsibility to the project.
  - b. This feature supports all the same requirements for the Survey View for Participants (see above #2) plus the following:
    - i. View comments submitted by participants via survey
    - ii. Separate vertical scroll for comment data region
    - iii. Search comments
      1. Researcher can search comments by comment content, participant's name, role, and dates fields using a keyword or keyword phrase.
    - iv. Sort comments
      1. Researcher can sort comments by start or end time (of comment), last updated time, participant's name, and role (instrument). Participant name and instrument role are sorted in ascending alphabetical order, and times are sorted ascending numeric order.
    - v. Filter comments
      1. Researcher can filter comments by instrument, groups, participant name, comment time and update time.

2. Instrument filter is a select (dropdown) box and it shows all instrument names as options.
3. Group filter is a select (dropdown) box and it shows only groups available to the survey.
4. Participant filter is an input free-form text field that filters by keywords found within the participant's name. For example, if a researcher wants to filter comments to see only those submitted by a participant with a name containing "dan", then the researcher would enter "dan" in this field, and only comments submitted by participants with names such as "Dan", "Daniel", "Danielle", or "Eldan" would be shown.
5. Researcher can edit/delete their own comments
  - a. Edit/Delete options are only shown for their own comments
  - b. Edit panel is not shown for comments submitted by someone else (such as a participant)
6. Researcher can filter out participant comments to view only their own comments.
7. Researcher can reset all search, sort and filter parameters.
8. Researcher can download data *(Not implemented)*
9. Researcher can visualize data along a timeline to allow a researcher to see which parts of the video where most commented on. *(Not implemented)*

<div style="margin-bottom: 10px;"> <input style="width: 100%;" type="text" value="search"/> <input style="float: right;" type="button" value="Search"/> </div> <div style="margin-bottom: 10px;">       Sort By:       <div style="border: 1px solid #ccc; height: 20px; width: 100%; position: relative;"> <div style="position: absolute; right: 5px; top: 5px;">⌵</div> </div> </div> <div style="margin-bottom: 10px;">       Filter: <input checked="" type="checkbox"/> <div style="border: 1px solid #ccc; padding: 2px; margin-top: 5px;">Instrument</div> <div style="border: 1px solid #ccc; padding: 2px; margin-top: 5px;">Group</div> </div> <div style="margin-bottom: 10px;"> <div style="display: flex; justify-content: space-between; align-items: center;"> <input style="width: 70%;" type="text" value="search participant"/> <input style="width: 25%; text-align: center;" type="button" value="Search"/> </div> </div> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;">       Comments From:       <div style="border: 1px solid #ccc; padding: 2px; margin-top: 5px;">FromTime</div> </div> <div style="width: 45%;">       Comments To:       <div style="border: 1px solid #ccc; padding: 2px; margin-top: 5px;">ToTime</div> </div> </div> <div style="text-align: center; margin-top: 5px;"> <input type="button" value="Filter"/> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%;">       CreateTime From:       <div style="border: 1px solid #ccc; padding: 2px; margin-top: 5px;">FromTime</div> </div> <div style="width: 45%;">       Comments To:       <div style="border: 1px solid #ccc; padding: 2px; margin-top: 5px;">ToTime</div> </div> </div> <div style="text-align: center; margin-top: 5px;"> <input type="button" value="Filter"/> </div> <div style="margin-top: 10px;">       Only see comments from researcher: <input type="checkbox"/> <input style="float: right;" type="button" value="Clear All"/> </div>	<p><b>Figure 3. Survey View for Researchers: Sort, Filter or Search Participant Data</b></p>
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## Summary/Future Work

Unfortunately, there was not enough time for rigorous acceptance testing. There was a problem deploying the application to the production server. Therefore, we each pulled the final version from GitHub and tested our own features (after merging each sub-team's changes) and tested the complete application. This did reveal some issues which were addressed and fixed prior to the Client's tests. Then we conducted acceptance testing with the technical liaison Celine Brass. She pulled our changes from GitHub onto her laptop, and then ran and tested the application locally. Tests were conducted to test the requirements listed above. The following tasks were tested:

- Researcher: Upload videos and/or audio track
  - 1-4 videos **with** separate audio track
  - 1-4 videos **without** separate audio track
- Researcher: Upload videos and/or audio track **and** create video segments
  - 1-4 videos **with** separate audio track **and** create 1-3 video segments
  - 1-4 videos **without** separate audio track **and** create 1-3 video segments
- Researcher uploads were tested on videos of the following formats and sizes:
  - Video
    - .MTS, .MP4, .AVI
  - Audio
    - .WAV
  - Sizes
    - File sizes up to 5 GB work
- Create a survey, add video group to survey and invite participants
- Participant: Survey View
  - Play videos
  - Toggle between videos
  - Toggle primary audio track on/off
  - Add new comment
    - Start and end times automatically triggered by typing into comment field
    - Start and end time triggered by "Start Timer" and "Stop" buttons
    - Start and end times entered manually by user
  - Edit comment
  - Delete comment
  - Submit survey
- Researcher: Survey View
  - All of the same tasks from above (Participant: Survey View)
  - Search comments

- Sort comments
- Filter comments

Due to time constraints and inadequate previous documentation, we could not deploy the application to production. Our team recommends that the Client focus on setting up the production environment to host this application first. The errors focused on the following items:

1. Node's 'Forever' module is supposed to allow the application to run forever once a user logs out of the EC2 instance. However, the module documentation did not work so the application only runs on the server while we SSH into the server.
2. Node's 'Socket.io' module calls network timeouts after a few minutes of uploading files. With slow Internet connections, this problem must be fixed. The 'disconnect' module needs a way to remain on the same POST request for uploading and/or a way to automatically resume uploading if the page times out (disconnects) and then reloads the page (reconnects).

Once it is running in production, then the Client should conduct extensive testing and document any bugs and/or issues.

Also, several dependencies and packages are "pinned" to older versions in this application. This makes the application difficult to install and run, and also difficult to deploy. In fact, when we first deployed the application to production, we were forced to run a newer version of Node.js. We recommend beginning the update process to the latest version of Node.js and then update any necessary package/modules dependencies.

Another area that needs to be addressed is the user interface across the application. During our usability testing of MERID v2, it was revealed that users were easily confused by the overall design of the application. However, in discussions with the Client, we established that this was not our team's priority. A few simple changes might enhance the application greatly, such as, consistent and clear labels, form instructions, placeholders and validation.

Client-side form validation was integrated into the survey view for participants using jQuery and into the media upload process. Typically both client-side and server-side validation are recommended. Both techniques ensure the data is valid before it is inserted or updated on the database. However, client-side validation is especially helpful from a user's perspective because it provides useful feedback before submitting a form. It is important to note that client-side validation can be thwarted by malicious users. However, for this application, users are authenticated researchers and participants known to researchers so server-side validation may not be as critical. At the very least, client-side validation should be fully integrated into each form.

Although application is built on bootstrap which is responsive to mobile devices and screen sizes, it was not tested with users on mobile devices. This area needs to be tested and then feedback from users should be integrated to enhance its usability on smaller screens.

During the 15 weeks allotted to complete this project, we regularly reviewed and reprioritized requirements with our Client. As unknown issues surfaced, our time was realigned to resolving those issues, and as a result a few specifications that were initially part of our requirements were pushed down in the list of priorities. It was agreed by the Client and our team that the quality of the product we delivered was more important than delivering a lot of features (with bells and whistles) that were buggy. Therefore, the following specifications were not completed as part of the MERID v3 release:

- Researchers download (participant) data (#3 above)
- Researchers visualize data along a timeline to allow a researcher to see which parts of the video where most commented on (#3 above)
- Warn user that once a survey is submitted, it cannot be changed (#2 above)

Even though the timeline visualization was not completed, a prototype was developed for the researcher's timeline visualization using Python and D3 (a data visualization module). This code has also been delivered to the Client which should provide a good start to the integration of this feature.

## Handoff

The code for MERID v3 is available on the dev branch on a private GitHub repository that the Client has access to. The README file has been updated to reflect accurate MERID v3 dependencies as well as how to install and start the application. Details and links to each of these resources follow:

- GitHub Code Repository - <https://github.com/clandorf/Merid-V2/>
- Documentation - <https://github.com/clandorf/Merid-V2/wiki>
- Installation Instructions for Developers running Mac OS 10.10 (Yosemite) - <https://github.com/clandorf/Merid-V2/wiki/Installation-on-Mac-OS-10.10.5-%28Yosemite%29>
- As stated in the feasibility study, our team operated under the [BSD 3-Clause License](#) and this license has been added to the code repository - <https://github.com/clandorf/Merid-V2/blob/dev/LICENSE>