**Wide-Field Ethnography Navigator**

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# Abstract

BeamCoffer Dataset is a part of the Collaboration in the Wild research project designed to study how professional software developers collaborate on their work in their workplace. (Socha, BeamCoffer Dataset: Professional Software Developers Collaborating in the Wild, 2019).

To study this collected data further, Professor David Socha, along with his fellow researchers has designed a set of practices and standards, called “wide field ethnography”.

Wide field ethnography enables researchers to focus on the multimodal and continuous nature of interaction and social phenomenon, cognition and work. (Socha, Jornet, & Adams, Wide Field Ethnography and Exploratory Analysis of Large Ethnographic Datasets, 2016)

However, wide field ethnography still requires the development of a concrete tool to enable the study. This tool is called Wide Field Ethnography Navigator. This project aims to work on building additional features on top of an exisiting preliminary version of the WFE navigator. (Oga & Socha, 2016) The specific features to develop are defined in the Chapter III.

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# Chapter I: Goals/Vision

## Problem Statement

The idea of wide-field ethnography allows one to study multiple data streams with overlapping coverage of the same area. These streams could be from different angles, different viewpoints, different equipment, and so on. However, wide-field ethnography lacks a concrete tool for undertaking this study. (Socha, et al., 2016)

To fill this gap, a tool called wide-field ethnography developer is being developed by Professor Socha’s research team. This capstone project aims to continue the development of wide field ethnography navigator to fill this crucial gap in wide-field ethnography. This project will implement several new features, as defined in later sections on the top of a preliminary version of the WFE navigator.

**Purpose of the Study**

This specific project focuses on continuing the development of the wide field ethnography navigator. (Vasisht, 2017) This specific project will build on work done by earlier researchers: Professor David Socha himself, and his earlier students, including Lalin "Irene" Wachirawutthichai and Wai Wang, in the development of a wide-field ethnography navigator, and work to build several new features.

Professor Socha collected the whole Beam Coffer dataset, which is footage of the office of a software development company. Professor Socha made use of 9 GoPro cameras, 6 high-quality Zoom H2n audio recorders, screen capture software and a handheld camera – all running concurrently.

Wei Wang created a tool to generate a SQL-based metadata index from this collected data. Some fields captured by this metadata include the *file\_path, scan\_root, width, height, duration, mtime\_begin, mtime\_end, nominal\_date, media\_type, is compressed, is original, equipment, location, file\_ext, origin\_path, related\_paths, data\_part\_name, dataset\_name, volume\_serial, pc\_user and pc\_hostname.* (Wang, 2016)

Lalin "Irene" Wachirawutthichai has developed and continues to develop, the preliminary version of the WFE navigator. My work will be focused on improving the system developed by Lalin "Irene" Wachirawutthicha, and improving the tool developed by Wei Wang.

The new features to be developed on top of the WFE navigator built by Irene are defined in section 2 of Chapter III (positioning your capstone). In simpler terms, this project will work towards the productization of the wide-field ethnography navigator.

## Stakeholders and beneficiaries

The key stakeholders and beneficiaries of this project are the people who own WFE datasets, which are multiple streams gathered over a particular area, and could be used in wide field ethnography and the researchers who are trying to search those datasets using the WFE navigator tool to gain valuable insights from the videos captured in the dataset. (Socha & Sutanto, The “Pair” as a Problematic Unit of Analysis for, 2015)

# Chapter II: Criteria

## Minimum, expected, and aspirational

## Targets

This project aims to work on several new features, some of which are:

1. Productizing the system:

* Minimum: Installer for the browser-based application can only be built on the target platform (e.g., MacOS installer on a Mac)
* Expected: Build an application that works on both Windows and MacOS
* Aspirational: Azure DevOps CI/CD pipeline automatically builds Windows and MacOS downloads

Quality Metrics:

1. Installation time and installation file size on Windows and MacOS. The lower the better

2. For Aspirational case, build time for Azure DevOps timeline.

2. Improving the graphical user interface (GUI) of the tool

* Minimum: Some improvement to the GUI developed by Irene W.
* Expected: Continually improvement of the GUI layout and components; users find the GUI easy to use
* Aspirational: Add new types of functionalities to the GUI

Quality Metrics:

1. Manual user reviews of the re-designed GUI

3. Ability to save/reload/share the current GUI state

Minimum: Save and reload 1 GUI state locally on the machine

Expected: Save and reload multiple GUI states locally on the machine

Aspirational: Share the GUI state with other users, across Mac and Windows.

Quality Metrics:

1. Time taken to save/reload the current GUI state.

4. Implementing SOLID design principles

Minimum: Implement the S and O of the SOLID principles

Expected: Implement the L and I of the SOLID principles

Aspirational: Implement all 5 SOLID principles.

Quality Metrics:

1. Manual verification to verify that the SOLID principles have been indeed implemented as desired.

5. Completing the move to redux (a database system used with React)

Minimum: Implement redux for storing video query history

Expected: Implement redux for storing the GUI state locally

Aspirational: Implement redux for all components of the application

Quality Metrics:

1. Time taken to save/reload the data, for each of the features, using redux. The lower the better.

6. Adding automated unit tests

Minimum: Write automated unit test for all new model objects

Expected: Use the red-green-refactor pattern of test-driven development when implementing any model object code. Have 100% path coverage for new model code. Write test cases using Selenium WebDriver for 5 of the features defined here.

Aspirational: Write test cases using Selenium WebDriver for all of the features defined here.

Quality Metrics:

1. Total number of use cases with fully written unit tests. The higher the better.

7. Improving the existing system for creating SQL media database from raw media files

Minimum: Identify the scope of improvement in the existing system

Expected: Implement at least half of the identified areas of improvement.

Aspirational: Implement all of the identified areas of improvement.

Quality Metrics:

* 1. Improvement in terms of the redundant data removed and the final size of the database.

8. Allowing users to edit a media recording (such as date/time)

Minimum: No change

Expected: Allow users to modify the date and time of the media files

Aspirational: N/A

Quality Metrics:

* 1. Verify the edit media recording functionality works.

9. Adding bookmarks support: adding, editing, deleting, and sharing bookmarks

Minimum: Add support to add and delete bookmarks

Expected: Add support to edit and search for bookmarks

Aspirational: Add support to share bookmarks with other users of the WFE navigator

Quality Metrics:

1. Verify that all functionality is working as described.

2. Measure that at least 100 bookmarks are stored successfully. (Can be done manually).

10. Exporting clips for analysis in other systems:

Minimum: Export a text file specifying the media files that cover this clip, including the offsets of the start and end of the clip

Expected: Export clips for use in Transana. If clip spans multiple media files, the exported clip also will contain multiple media files

Aspirational: Produce a single media file, even if the clip spans multiple media files

Quality Metrics:

Minimum: 1. Verify that all exported clips satisfy the desired criteria.

Expected: 1. Verify all clips are exported to Transana

Aspirational: 1. Verify the final media file consists of all individual streams combined.

11. Handling image streams

Minimum: Allow users to select an image stream and have it automatically displayed

Expected: Visually indicate how “old” an image is, where old is defined by the difference between the time at which the slider is located and the time when the image was taken

Aspirational: Allow the definition of “old” to be configured by the WFE Navigator user. Allow different definitions for each stream.

Quality Metrics:

* 1. Manually verify all of the features work as described.

12. Visualizing audio streams

Minimum: Don’t visualize audio streams

Expected: Provide one audio stream visualization for the first. Only display audio visualization when the stream’s “visualize” button is selected

Aspirational: Allow users to select from a range of different visualizations

Quality Metrics:

* 1. Verify the maximum number of audio streams that are visualized, when multiple video streams are played.

**Chapter III Positioning Your Capstone**

**What existing systems/research are similar or related to your proposed system?**

This project will work on extending features on top of the existing Wide Field Ethnography Navigator, which in its most recent iteration was developed by Irene Wachirawutthichai. Irene is a master’s student at the University of Washington Bothell, and she is doing her capstone project with Professor Socha.

Some systems like this capstone project are:

[Transana](https://www.transana.com/): A closed source and paid tool that can annotate and make transcripts for multiple streams of videos. (Woods, 2022)

[VALT](https://www.ipivs.com/products/valt-software): A paid and software-as-a-service tool that allows users to view simultaneous streams of videos captured from their proprietary CCTV systems. (Intelligent Video Solutions, 2022)

[VLC Media player](https://www.videolan.org/vlc/) allows users to play up to 2 videos simultaneously. (VideoLAN, 2022)

[Awesome Video Player](http://www.awesomevideoplayer.com/) is a freemium software system that allows users to play up to 16 videos at once on each screen, in a grid. (Awesome Video Player, 2022)

These tools were selected for comparison amongst several other available tools, as other tools were too outdated, or not easily accessible.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Transana | VALT | VLC Media Player | Awesome Video Player |
| Datasets | 10s (few) | NA | No Limit | NA |
| Intent | Annotate, Detailed Analysis | Navigate | Navigate | Navigate |
| Data Prep | Create Transcripts | NA | NA | NA |
| Data Gathering | All sources supported | Proprietary CCTV systems | All sources supported | All sources supported |
| Share Analysis | Video, Audio, Code, Transcripts | NA | NA | NA |
| Business Model | Paid | Paid, part of a CCTV ecosystem | Free & Open Source | Freemium |
| Play back | 1 video at a time | 16 videos at a time | 2 videos at a time | 16 videos at a time |

Table 1 Competitive Analysis of Tools similar to WFE Navigator

**What do you expect to borrow, adapt, or otherwise take from existing systems and relevant research?**

This system will specifically extend the current version of the wide field ethnography navigator built by Irene. In its current state, this system performs the following tasks:

1. Fetch the list of streams from the source dataset that match the required parameters (like date, type, location, device used etc.)
2. Load the streams for viewing in the current browser canvas
3. Plays all streams in synchrony
4. Volume control to control each stream’s volume independently, from 0% up to 300%
5. Ability to play the audio and video streams, including independently playing the audio and video streams from the current stream being played
6. Ability to scroll forward or reverse in the stream
7. Modify the playback speed of the video streams being played

## This capstone project will build the features defined above on Irene’s current version of the wide field ethnography navigator. Most of the features added will be new features, developing independently of the above features.

## How is your system different from these systems?

My system will be built on top of the system built by Irene. However, my specific system is entirely different from any of the existing systems, due to the following reasons:

1. While the system will build upon the already available version of WFE navigator, all of my contributions to this system will be entirely unique and will not borrow any of the features from existing WFE navigator versions.

2. The system will be fully open source, unlike most of the systems mentioned above

3. The system will allow 100s of videos to be played simultaneously, which is a lot more than what other existing systems do.

**How will this capstone demonstrate your competence in computer science and software engineering?**

I will build a lot of the required features from scratch, which will involve a thorough study of the available tools and methodologies for each feature that has to be implemented. After a detailed theoretical study, I will write code for all of the features. After the features have been written and coded, I will perform their testing.

All of the above steps will sequentially demonstrate my competence in the field of computer science and software engineering. My competence in designing, building and maintaining a scalable browser-based system will be demonstrated through this capstone project.

**If your work is part of a group or collaborative project, position your contributions within the larger project; this could be done via a statement such as**

This project is part of a larger group project Wide Field Ethnography, under the direction of Professor David Socha at the University of Washington Bothell. The project team currently includes Irene W. In the past, the project included others, specifically Wei Wang. My responsibilities will involve/include productizing the WFE navigator, improving Wei Wong’s SQL tool, adding new features to and otherwise improving the WFE navigator. The goal of the current project is to produce an upgraded WFE navigator that can be used by researchers on either Windows or Mac computers. For a full description of this team project, see Appendix A.

# Chapter IV: Plan

## Detailed milestones for key deliverables

In this section, I will explain the expected completion date for all the key points mentioned:

1. Productizing the system: This is the overall project milestone, the culmination of all other features.
2. Improving the graphical user interface (GUI) of the tool: Designing the new GUI is expected to take around 1 week of time in the Winter 2023 quarter.
3. Ability to reload/save/share the current GUI state: First 3 days of the second week of Winter 2023 quarter.
4. Implementing SOLID design principles: Last 4 days of the second week of Winer 2023 quarter.
5. Completing the move to redux (a database system used with React): First 3 days of the third week of Winter 2023 quarter.
6. Adding automated unit tests: Last 4 days of the third week of Winter 2023 quarter.
7. Improving an existing system for creating SQL media database from raw video files: Entire 4th week of the Winter 2023 quarter.
8. Allowing users to edit a media recording (such as date/time): First 4 days of the fifth week of the Winter 2023 quarter.
9. Adding bookmarks support: adding, editing, deleting, and sharing bookmarks: Last 3 days of the fifth week of Winter 2023 quarter.
10. Exporting clips for analysis in other systems: First, we need to examine the other systems to see how feasible this feature request is in itself. The entire process would take the sixth week of the Winter 2023 quarter.
11. Handling image streams: First four days of the seventh week of Winter 2023 quarter.
12. Visualizing audio streams: Last three days of the seventh week of Winter 2023 quarter.
13. Making the final capstone project report: multi-week effort, beginning from 8th week of the Winter 2023 quarter, and likely to extend beyond half of the Spring 2023 quarter, until final capstone defense.

**Explanation of how you propose to do the work, including the software development lifecycle and processes you propose to follow**

I am planning to make use of several well-known tools, such as Azure DevOps and GitHub for efficient software development. Azure DevOps will be primarily used managing our work logs and plans with my fellow researchers, whereas GitHub will be used for code maintenance and management.

On the SDLC side of things, most of the work is expected to take place on design and development, and testing side.

Further, I will make use of agile software development methodology, implementing the required features one after the other. We are using agile methodology over others, as the deadlines are not very rigid, and the methodology for implementing the features is not well defined either at this point.

# Chapter V: Constraints, Risks, and Resources

## Key constraints

The biggest constraint in this project is expected to be time availability and technical knowledge of the systems that must be built. As of now, I do not anticipate any other constraints like monetary or computational resources.

**Resources you will need for success**

As of now, there are no factors that are outside my control. In the aspirational goals for the project, we might need to obtain code from some other systems, that use browser-based machine learning for object detection. But, for the expected success level, no external resources are expected to be required.

## Risks you anticipate

The biggest risk is missing on the provided timelines, which could lead to a delay in the development of this project and consequently the project defense.

# Chapter VI: Evidence

# Evidence

This is a master’s project, that will involve developing some features from scratch. There are claims made as such that require the presentation of evidence.

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# Appendix A: Team Members:

1. Lalin “Irene” Wachirawuttichai.