# MSAI 495 Potential Final Projects

The purpose of the final projects, which are open research projects, is to let you put together the techniques we have discussed in classes, and obtain a comprehensive and profound understanding of them.

The following is a list of potential topics for the final projects you may want to choose from. I only give rough descriptions of the projects, but leaving spaces for your imagination, as they are open-ended research projects. If you are interested in a topic that is not covered by this list, please make sure to talk to me in advance. Actually, I hope to see many different final projects. So, be creative.

Group projects are acceptable. Each group should not have more than 2 students.

## 1 Your Report and Optional Presentation

Each student should submit an individual 15-page (double space) report on the project you've done. You can partner with another student for the project. Each group cannot have more than 2 students.

- **The Report (required)**: Each student should hand in an individual (double-space) 15-page (**minimum requirement**) report. The due date is 6/11/2025. Late submissions are not acceptable. During the report, I expect at least the followings:

  1. **Your personal views** about the fields and its applications, a brief description of what you have learned in this course, and what you want to study more;
  2. **Project description** including the goal and the problem statement;
  3. **Your design** which describes all the technical details of your approach and implementations;
  4. **The result and analysis** of your design;
  5. **Remarks and future work**, which describes what you think the most important things to improve the results, what topic you think we should learn more.

Note-1: Submit your report as a PDF file, and don't zip it with any other files.

Note-2: You also need to submit the code of your project. **The code should be in a .zip file. Don't insert your code in the PDF report.**

- **Youtube Presentation (required)**: MSAI 495 (ECE 332) has a tradition of having a mini-workshop in the last week. As the class is getting very large, it is impossible to have all students to present projects. As project presentation is a very important part of a research project, every student needs to work on it and obtain experiences to improve. Thus, every group needs to prepare a video presentation for submission:

1. The deadline of submission is 6/05/2025 at 9:00am (or before class)
2. The video presentation is 20-min long;
3. The video should include your slides and your faces
4. Your presentation must include:
   - The goal you want to achieve;
   - Your approach and your design;
   - Your results (showing the result sequences);
   - How to improve your result if you have one more month.

- **The In-class Presentation**: All projects will be presented in our Mini-Workshop in the last week (6/03/2025 and 6/05/2025) class. In the short presentation, you only give a highlight of your project. Each talk will have up to 7 minutes including Q&A.

# 2 The `FingerCursor` Project

In the `FingerCursor` project, the index fingertip can be used to control the mouse, i.e., the mouse moves with you fingertips. You can analyze the video that I provided, or you can make your own testing video (that I suggest you do).

The idea of a `FingerCursor` is to detect, locate and track a fingertip through a video sequence accurately and robustly. *The key point is to locate and track the fingertip of the index finger accurately.* You can design a set of specific finger actions, and use them for command and control (of the cursor or other things).

You can use any "tool" we have studied in class, and make things work. The creativity of your projects will be reflected on how you design your project. You can also design other fancy applications. I pretty much leave it up to you. Actually, any other interesting application (instead of `FingerCursor`) is highly welcome.

# 3 The `ImageGoogle` Project

In this `ImageGoogle` project, you are creating an image database system for managing a fairly large set of images collected during your travel.

You may have hundreds or even thousands of images when you come back from several trips. I bet they are pretty much un-organized (i.e., you don't have to sort, categorize, and annotate them). So, you end up with a large set of images sitting in a folder. Each time when you want to find some photos to share with your friends, you may have to browse and search them one by one from the very beginning. This is so frustrating. And we need a smart way for this purpose. This is indeed an image retrieval system, in which you can do googling on images (over your own image databases).

The problem can be stated as follows: given an image of interest (i.e., the query image), find a set of "similar" images in the database, and sort them. A very critical research issue here is to define the similarity between images. In class, I've suggested three ways: (1) global color histogram, (2) image layout and block-based color histogram, (3) RAG-based

descriptions. As this is a quite open problem, I hope you can come up with your ways in representing images and defining the similarities.

Besides the image similarity, another research issue you might want to keep in mind is the searching for the similar images. Without pre-organizing (or indexing) your database, you need to check each image one by one. This may be very slow if you have a large number of images. So, you need to have some kinds of index for the databases so as to speed up the search.

# 4 The `FaceBook` Project

In this `FaceBook` project, you are creating a face recognition system that can recognize your classmates in EECS 332.

You can collect a database by taking shots of all your classmates (or using their other photos), so that your `FaceBook` system can memorize them in advance. Then you need to create the recognizing system (this is your research). Each time when your classmate enters the classroom, your system can check if or not the one is indeed your classmate.

The critical issue in this project is to extract image features for the faces, and define similarities based on them. The recognition can be done simply by matching the features of the input images with the images in the databases you have.

Much research has been done on this topic. You can easily find references. I suggest you follow one specific method you like most, implement it and improve it.

# 5 The `ImageMosaic` Project

In this `ImageMosaic` project, you are expected to create an image panorama by stitching a set of images together. These set of images are on the same scene, but from a set of overlapping field of view (i.e., various view points). For example, you can take several photos of the lake front of Lake Michigan, and put them together.

Technically, there are two important steps you need to do research: (1) image registration (i.e., geometrically aligning image pixels from different images), and (2) image blending (i.e., minimizing the photometric distortions in fusing images).

# 6 The `SmartErasor` Project

In `SmartErasor`, you are required to implement a program to erase several characters automatically and gradually in a given video, while keeping the background texture unchanged perceptively.

The input is a video segment [1], in which there is a foreground "Can you erase me?", and the background of the video is a newspaper texture, as shown in Figure 1. You will also notice that on top of the noisy characters there is a pen tip that keeps moving from right side to the left as the video runs. For example, in Figure 1 (a) that is the 100th frame

[1] image frames are extracted from this video, you can download these images from our course website

extracted from the video, the current pen tip's location is on top of noisy word "me?", so your program should use this location as an indicator, and erase the noisy words between this location and the right side of the noisy sentence. Several output frames are shown in Figure 2

The location of the pen tip can be effectively obtained by using the visual tracking technique covered in class, and the erasing work can be done by the texture impainting techniques.

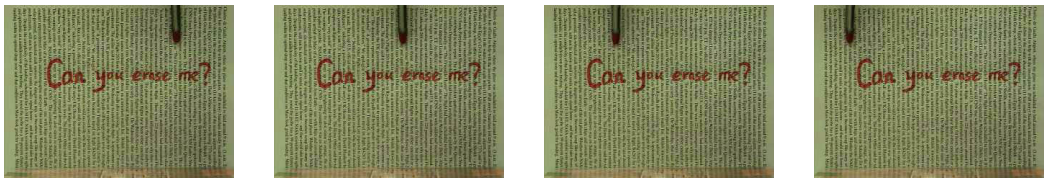


Figure 1: Input Image Frames, (a) 100th frame, (b) 200th frame, (c) 300th frame, (d) 400th frame


Figure 2: Output Image Frames, (a) 100th frame, (b) 200th frame, (c) 300th frame, (d) 400th frame