COP 4931 Project Description

Last Update: February 14, 2024

1 Getting Started

This course project involves gathering biometric data to construct and evaluate a ***multibiometric user authentication system***. While you will collect facial data, you have the option to supplement this with data from other modalities sourced from publicly available free databases, as listed below (note that you are free to explore additional datasets that are freely available for educational purposes):

- Faces: https://data.vision.ee.ethz.ch/cvl/rrothe/imdb-wiki/
- Palmprint: http://ivg.au.tsinghua.edu.cn/dataset/THUPALMLAB.php
- Keystrokes: https://www.cs.cmu.edu/~keystroke/
- Hand Gestures: https://ieee-dataport.org/documents/dataset-dynamic-hand-gesture-recognition-systems
- Voice: https://github.com/soerenab/AudioMNIST

2 Data Collection

You will collect your own video data to simulate scenarios that might be suitable continuous authentication. Specifically, over a span of several days, you must record at least five (5) videos, each lasting a minimum of 1 minute, while engaging in various cognitive activities such as:

- Checking your email.
- Writing a short essay using a text editor like Microsoft Word.
- Reading a short article and taking notes.
- Watching a brief educational video and summarizing it.
- Solving a simple puzzle or brainteaser.

Figure 1: Example viewpoints for your data collection.

These tasks should result in a range of 'normal' behaviors observed during computer usage (e.g., avoiding active participation, such as deliberately looking at the camera). Note that given this scenario, the user's behavior reflects habituation and is, thus, non-cooperative, occurring under uncontrolled conditions.

This project also involves simulating **multi-sensor** and **multi-sample** scenarios, allowing exploration of various camera sources and camera placement options, including:

- Using the built-in camera on your computer or laptop.
- Positioning your phone (in landscape or portrait mode) in front of you to act as the camera while you type on a computer or laptop.
- Placing a detachable webcam in different locations such as above the monitor, to the side of the monitor, or at eye level.
- Mounting a camera on a tripod at varying distances and angles from the user.

In each video, you should be the only person captured, similar to the screens depicted in Figure 1. Each video must be recorded on a different day to introduce variations in clothing, hairstyle, lighting, cognitive activities, camera angles, and environmental conditions. Along with each video, record the following metadata in the file `metadata.xlsx`:

- Date and time of recording.
- Description of the cognitive activity performed.
- Camera placement details (see Figure 1).
- Any additional relevant information about the recording environment.

Rename your videos to follow the following convention: `lastName_video#.mp4`, for example, `Neal_1.mp4`, `Neal_2.mp4`, and so on. Place all videos in .mp4 format only in a folder, along with `metadata.xlsx`. Zip the folder and upload to Canvas.

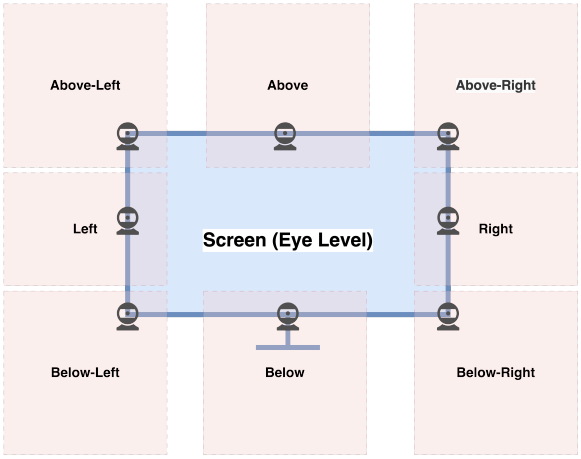

Figure 2: Camera Placement: For example, 'Below' indicates the camera source placed below eye level.

3 Project Groups

You will collaborate in groups, with a maximum of two students per group. **Self-sign-up for project groups ("Project Groups") via Canvas is available until February 23, 2024, 11:59 PM.** It is crucial to have all groups finalized by this deadline, as no changes to groups will be permitted beyond this point. Working individually is an option, and groups must not exceed 2 members.

4 Building an Authentication System

In this project, you will use the developed dataset (and any additional datasets, if you wish) to design, develop, and assess the performance of a user authentication system using appearance-based, texture-based, and/or some other face analysis technique of your choice.

5 Project Expectations

For this project, you must formulate and investigate a minimum of **two** research questions, while also adopting a multibiometric approach to enhance the depth and robustness of your exploration. Specifically, every project must implement at least one form of fusion in your system (refer to Lecture 6 for details).

Research questions play a pivotal role in any investigation as they define the overarching purpose and guide the trajectory of the research endeavor. Formulating clear and concise research questions is crucial because they not only provide a focused direction for the study but also serve as the foundation for hypothesis development and subse-

quent data collection and analysis. Well-crafted research questions enable researchers to delineate the scope of their inquiry, facilitating the identification of variables and factors that merit exploration. Furthermore, these questions act as a roadmap, helping researchers navigate the complex landscape of information, ensuring that their efforts contribute meaningfully to existing knowledge. In essence, the significance of research questions lies in their ability to shape the entire research process, ensuring purposeful, systematic, and impactful investigations.

Example Research Questions

Here are two example research questions related to fingerprint recognition, along with a corresponding research plan:

- *How does the number of minutiae points affect recognition performance?*
- *How does age impact fingerprint recognition performance?*

Corresponding Research Plan

Measure authentication performance when increasing the number of minutiae points extracted per fingerprint from 10 to 100 in increments of 10. This analysis will be conducted separately for subjects aged 18-25, and subjects aged 65-72. Further, this work will adopt a multi-instance and multi-sample approach by capturing five fingerprint scans per finger per person.

6 Report

Write a report describing your project and its outcomes. Be sure to document all conditions in your report detailing how your results were obtained. Here's a general layout:

Introduction Define biometrics and a biometric system. Introduce face recognition. Provide a brief description of what your project is about, your methods, and what your results show.

Related Work Provide a summary of published research literature that is related to yours. You can search Google Scholar, IEEE Xplore, and ACM Digital Library to find papers. Papers relevant to your project will be those that relate to your research questions. This section should show similarities and differences between those papers and your approaches, and potentially how your approach offers new insight that prior work has not. You must discuss and cite at least 5 articles in this section. Note that any other section can include in-text citations (and, thus, additional references) as needed.

Method Detail your methods (i.e., the dataset, any preprocessing, features, matching, decision, any fusion, etc.). This should be clear enough that someone else could

replicate your experiments by just reading this section if they had access to your dataset.

Results Use the appropriate plots and error rates (and any other metrics) to describe the performance of your system. Show example images when this could be useful for the reader. Don't just provide performance numbers, but try to explain why you think these numbers were achieved.

Conclusion Use your results to answer your research questions. List any items in particular worth mentioning again. What did you learn? What was hard and easy for the system? What would you like to do in future work? What were the limitations of your approaches?

References

Important:

- The article should be proofread! Use the USF Writing Center if necessary to help improve the readability of your report.
- The article should tell a story. It should flow from sentence to sentence and section to section.
- Here are example articles that follow a similar structure. Use these as a guide.

1. Ebraheem, M., King, S., Neal, T. (2022). Lip Movement as a WiFi-Enabled Behavioral Biometric: A Pilot Study. In: Stephanidis, C., Antona, M., Ntoa, S. (eds) HCI International 2022 Posters. HCII 2022. Communications in Computer and Information Science, vol 1583. Springer, Cham. **(attached)** https://doi.org/10.1007/978-3-031-06394-7_59
2. Khadija Zanna, Tempestt Neal, and Shaun Canavan. 2021. Clustering of Physiological Signals by Emotional State, Race, and Sex. In Companion Publication of the 2021 International Conference on Multimodal Interaction (ICMI '21 Companion). Association for Computing Machinery, New York, NY, USA, 312–316. https://doi.org/10.1145/3461615.3486567
3. Sumpter, Matthew, and Tempestt Neal. "User Perceptions of Article Credibility Warnings: Towards Understanding the Influence of Journalists and AI Agents." (2021). https://workshop-proceedings.icwsm.org/pdf/2021_64.pdf **(attached)**

6.1 Formatting

You will use LaTeX to write your report. Use this template to write your report. **You should copy the project to create an editable version for your group. The report should be 5 pages (excluding images, tables, and references —**

this means if all images, tables, and references are removed, the remaining textual content should not be longer than 5 pages). The article should include

- images (i.e., any relevant photos to complement the discussion, performance plots, etc.)
- tables
- **very few** mechanical and grammatical errors

7 Rubric

The project rubric is provided.

8 Presentation

Project presentations are scheduled for May 2, 2024 (group schedule will be announced). The presentation rubric is provided.

9 Submission

Submit all code as .py files, your report as a .pdf file, and your presentation slides as a .pptx file. Package all files in a zipped folder. Do not submit data. **Due April 26, 2024.**