CIS4930 / CIS6930
BIOMETRIC AUTHENTICATION ON MOBILE DEVICES

COURSE PROJECT DESCRIPTION

The goal of the project is to introduce you to the current state of mobile biometrics by allowing you to implement your own biometric system using common modalities explored for mobile biometrics. You and your teammates will explore the research literature, develop a project idea, and implement the idea (using data that I provide). Each team will write a report which summarizes your results and give a brief presentation to share your experiences with your classmates. The project is worth 45% of your final grade.

EACH TEAM MEMBER MUST CONTRIBUTE EQUALLY TO THE PROJECT!

Teams

Green	Orange	Black	Blue	Purple	Red	Yellow
A. Accomando	K. Arjun	J. Cox	L. Kelly	M. Jaishanker	A. Armstrong	K. Bensimoun
R. Kauer	S. Pradhan	T. Nguyen	F. Villalpando	C. Meseha	M. Kramer	V. Nguyen
L. Lopez	C. Leon	F. Moomtaheen	J. Kurian	P. Ripkey	M. Serrano	V. Gampala

There are **three** parts to the project:

Task	Points	Due Date (11:59PM)
Literature Review	15	10/1
Project Description	15	10/19
Report / Presentation	15	11/25

Important:

- **Late tasks will not receive credit.**
- **Each team member should contribute equally to each task.**
- **You can submit a task at any time prior to the due date on Canvas.**
- **Only one member of the team should submit each task on Canvas. All team members will receive the same grade.**

- **Consider using Overleaf (LaTeX), Git, and/or Dropbox to share the project with your team.**

I: LITERATURE REVIEW

Read and take notes on the following papers:

1. W. Meng, D. S. Wong, S. Furnell and J. Zhou, "Surveying the Development of Biometric User Authentication on Mobile Phones," in IEEE Communications Surveys & Tutorials, vol. 17, no. 3, pp. 1268-1293, thirdquarter 2015. doi: 10.1109/COMST.2014.2386915 URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7000543&isnumber=7214344
2. Connor, Patrick, and Arun Ross. "Biometric recognition by gait: A survey of modalities and features." Computer Vision and Image Understanding 167 (2018): 1-27. URL: https://doi.org/10.1016/j.cviu.2018.01.007
3. Teh, Pin Shen, et al. "A survey on touch dynamics authentication in mobile devices." Computers & Security 59 (2016): 210-235. URL: https://doi.org/10.1016/j.cose.2016.03.003
4. Neal, Tempestt J., and Damon L. Woodard. “Surveying Biometric Authentication for Mobile Device Security.” Journal of Pattern Recognition Research 1 (2016): 74-110. URL: http://www.jprr.org/index.php/jprr/article/view/764/246

Your notes should be written as a one page, single-spaced, bulleted list. The margins should be 1” on each side, use Arial 14pt font. A note cannot exceed four lines. Do not copy and paste from the papers – your notes should reflect the fact that you discussed the papers with your teammates and developed your own thoughts about the material. Anything copied and pasted will not be accepted and can be penalized for violation of academic integrity. See the following page for a template.

Title of the Paper
Team Color

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In addition, find four more papers (use Google Scholar) on one (or more) of the following modalities (these are the modalities you can choose from your project):

- Gait
- Keystrokes / Touch Gestures
- User-Device Interaction

For each paper, answer the following questions in your own words (i.e., do not copy and paste):

- Who are the researchers? (Provide a full citation)
- What did they do? (Modality you chose)
- Where did they do it? (Where was data collected? Was data collected in a lab environment or in-the-wild)?
- How did they do it? (Summary of methodology / approach)
- Why did they do it? (What research gap were they addressing? Why was the work important?)
- What are the remaining problems/future work? (This is usually provided at the end of the paper.)

The submission for this task should be a single PDF file (including one-pager notes (there should be 4 of them) and question responses for your own papers).

I will grade based on the following considerations:

- Are the rules followed? (formatting, submission requirements, all questions answered for the four papers)
- Do the notes suggest that significant thought was given to the content of the papers?
- Did the team comprehend their chosen papers correctly?

II: PROJECT DESCRIPTION

Develop a project idea with your teammates based on your readings from Part I. Your project idea **must** be motivated by Part I. Write a description of your idea (2-pages minimum, single spaced, Arial 14pt font,1" margins, pdf) using the following six headers:

1. Data Acquisition
    a. Will you reduce noise or do any data enhancement?
2. Feature Extraction
    a. What features will you use and why?
    b. Will you use feature-level fusion? If so, what method will you use to fuse your features?
    c. Do you plan to use feature selection? If so, explain the method you will use.
3. Matching
    a. What matcher will you use?
    b. Will you use machine learning or a distance measure?
    c. Which machine learning algorithm or distance measure will you use? Why?
    d. Will you use score-level fusion?
4. Decision
    a. Will you use decision-level fusion?
5. Why did you choose this project, how was it motivated by Part I, and what do you expect to gain from carrying it out?
6. How might this project address a current challenge?

When devising your project plan, keep in mind the following requirements (and note your selections in the write-up):

- <u>You MUST use two or more of the following techniques:</u>
    a. Data enhancement / noise reduction
    b. Feature selection
    c. Machine learning
    d. Multiple biometrics
    e. Feature-level fusion
    f. Score-level fusion
    g. Decision-level fusion

- In addition to your two choices, <u>you must also experiment with one independent variable</u>; the dependent variables are your

performance rates. For example, you may explore how your performance changes as you change the number of training (or enrollment) samples per subject.

I will grade based on the following considerations:

- Has the team carefully thought about the project?
- Is the project plan described in detail?
- Did the team follow formatting directions?
- Are the expected outcomes (i.e., what the team plans to learn) clear?
- Did the team comprise a rigorous plan?
- Did the team note how they will address the two requirements?

Once your project description is submitted via Canvas, I will review it and provide feedback. After your team has reviewed the feedback, implement your project plan using a programming language (I recommend Python) over the next few weeks. Your next task will summarize your results.

III: IMPLEMENTATION / REPORT / PRESENTATION

Write a report (1” margins, Arial 12pt font, single spaced, pdf) summarizing your findings. Your report must not exceed 6 pages – do not include unnecessary blank lines. Write elegantly as if you are submitting your report for publication (which may be considered!). Your report must include the following:

- Introduction
  - Introduce the topic of the paper and any cool applications of the topic.
  - Why is your topic important?
  - What you will talk about/do throughout the paper?
- Background
  - What other people had to say / have done on this topic(s) (be sure to cite your references, and quote as appropriate). You should have already done this in the first task if your project was indeed motivated by these works.
- Method
  - Your approach to the problem
  - How did you design your experiments?
  - What modality (modalities) did you use?
  - Describe feature selection, fusion techniques, and matching algorithms as applicable.
- Results
  - What did/didn't work and why?
  - Include graphs, equations, pictures, etc. as appropriate
  - Include relevant observations, measurements, and statistics for each of your variants to the independent variable (i.e., what happens when you change ____, and what that means).
  - You must include ROC curves, EERs, score distribution graphs, and d-prime values.
- Summary
  - Try to draw together the intro, background, and results sections.
  - Restate important results and how your results compare to those in your background section
  - What was accomplished / learned
  - What you would have done differently
- References
  - Cite the papers that you used

Your presentation should consist of a PowerPoint of no more than 12 slides. Presentations will occur at the end of the semester from each team. Teams will be allowed a total of 20 minutes; 15 minutes are allotted to the actual presentation and 5 minutes are allotted to a question and answer session following the presentation. Each member must present something in the presentation. The presentations should briefly cover the following points:

- Project description and how it stemmed from/is related to previous research
- Description of the data and methods used
- Key results and insights
- Description of what worked and what didn't work and why

Zip all of your files (all programming scripts that you used to run your experiments – these should be **heavily** commented to understand the flow the code, report, and presentation slides) and upload the zipped folder to Canvas. Name the folder (<team_color>.zip).

I will grade based on the following considerations:

- Is the report format followed? Are all items addressed?
- Is the report readable?
- Did the team follow formatting guidelines?
- Are the results reasonable (for instance, low EERs)?
- Was my feedback incorporated into the project?
- Did the team follow their project description?
- Did the team thoroughly explain what worked and what didn't? Did the team attempt to explain why something did or did not work?
- Did the team appear prepared during their presentation?
- Did the team answer their peer's questions accurately after their presentations?
- Did the team clutter their slides with text? (The answer should be no)
- Did the team read directly from their slides? (The answer should be no – you should include mostly figures and present confidently.)