Course Project

CVI620/DPS920 Computer Vision

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

Contents

Project Description:

All students must participate in the course project to demonstrate and apply what they have learned about computer vision to a problem of their interest. While students are given the freedom to select project topics, content and execution, all projects must be related to real-world computer vision applications.

To ensure that students are on track with their final project, the following completion deliverables will be enforced:

Milestone deadlines

Project Milestone	Deadline
1. Project Proposal	**Friday, July 5, 2024, before 11:59 PM**
2. Project Plan Timeline	**Friday, July 12, 2024, before 11:59 PM**
3. Project Presentation (Narrated PowerPoint Slide) or (Videorecording)	**Friday, August 9, 2024, before 11: 59 PM**
4. Writing Final Report	**Friday, August 9, 2024, before 11:59 PM**

Instructions:

- The project can be completed **in a group of three or four (recommended)** (students in the same group will receive the same mark).
- Please submit the submission file(s) through Blackboard. **Only one person per group must submit, and only the last submission will be marked**.

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

Milestone1: Find Your Problem and Write Your Project Proposal (5% of final grade)

Your project proposal should be submitted through Blackboard (BB) as a PDF File (recommended, **.pdf**) or Word document (**.docx**).

You can pick a project topic that involves understanding the state-of-the-art vision models and building new models or improving existing models for a vision task. To help you pick your project topic:

1- **Choose what you would like to do**, and pick a problem that you can propose a solution for it **using computer vision algorithms**.
   We talked about the applications of Computer Vision in the first two weeks. Review the slides and choose an application.
   Other references:
   - There are several examples in Chapter 10 (available online through Seneca libraries) [**A Practical Introduction to Computer Vision with OpenCV**]

   - Also, see this book (available online through Seneca Libraries)

     [Mastering OpenCV 4 with Python](#), Villan, Alberto, 2019; 1

   - A good website with many applications: https://www.learnopencv.com/

2- **Research the project topic to gain more information**.
   Google the topic, read on Wikipedia and scan through articles (use library search) to get a better idea of the steps required.

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

3- Some of the Project Topics (Recommended)

    a. ***Alternate Tagging of Images:*** An alt tag, also known as "alt attribute" and "alt description," is an HTML attribute applied to image tags to provide a text alternative for search engines. Applying images to alt tags, such as product photos, can positively impact an eCommerce store's search engine rankings. Read more.

    b. ***OCR for transactional Receipts:*** The system extracts complete receipt data from any customer receipt or invoice, which can be in PDF or image format.

    c. ***OCR for reading medical forms:*** The system reads a static PDF filled with patient information and retrieves information. The medical form can be a pdf or image form.

4- Narrow down the application to make it suitable for a course project.

Examples:

Broad topic	Narrow topic (Project Title)
Object detection	Detecting a cell phone in an image
Optical Character Recognition	Extract text from the image.
Face recognition	Two-factor authentication by face recognition
Tracking	Detection of the user in front of the webcam (did the user get up and go?!)
Tracking	Tracking a cat in a short video
Augmented reality	Augmented reality in a classroom (adding horns on the teacher's head!!!)
Video processing	A simple video player and editor
Video processing	Summarizing a video by choosing a few frames
Motion detection	Motion detection using a webcam (did anyone enter the room?!)
Image processing	Stitching images for panorama
Geometry	Finding my classmate's heights using a calibrated camera
Tracking	Pose Estimation/ Gestures

5- Find at least three relevant references (links, articles, book chapters) for your project. In your project presentation, you will explain the methods and findings from these references. Attach a PDF of these references to your proposal and final report submissions.

Deliverables for Find Your Problem and Write Your Project Proposal Milestone:

Group members:

Project Title:

Project Description: The project proposal should include one paragraph (200-400 words) that describes your project at the abstract level.

Then, write and answer each of the following questions.

Write each question in your project proposal, followed by your response:

- What is the problem that you will be investigating? Why is it interesting?
- What are the relevant references (links, articles, book chapters) will you read or examine to provide context and background?
    1. ….
    2. ….
    3. ….

- (if applicable) What data will you use? If you are collecting new data, how will you do it?

You do not have to have an exact answer for the next two questions at this point, but you should have a general sense of how you will approach the problem you are working on.

- What method or algorithm are you proposing? If there are existing implementations, will you use them and how? How do you plan to improve or modify such implementations?
- How will you evaluate your results? **Qualitatively**, what kind of results do you expect (e.g. plots or figures)? **Quantitatively**, what kind of analysis will you use to evaluate and/or compare your results (e.g. what performance metrics or statistical tests)?

Submission: Only one person on your group/team should submit.

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

Some things to keep in mind about this milestone:

- Review the requirements for the other milestones in this project carefully to ensure that the project topic (or problem) you choose is rich enough to allow you to do a detailed, in-depth analysis of it for the remainder of this project. For Instance, running a noise removal filter on a set of images is probably not enough to be a project idea, or installing and running open-source code is not **sufficient**.

- You should generally try to avoid project topics that are *too complex* (or big) and require more than 7 to 8 weeks to complete. **For that reason, a good rule of thumb is that you should pick a relevant project topic related to your real-life that can be solved within 7 to 8 weeks.**

- **You can pick a project idea discussed in any reference paper and then work on improving the proposed solution in that paper.** If the reference paper you choose is from a specialized area (i.e. medicine, science, economics), make sure you explain it in a way that someone who doesn't know anything about the topic (including your fellow students and me) can understand what you are talking about.

- If, after answering the questions above, you realize that your project idea is too complicated or that you do not understand it properly, the best thing to do is to pick another idea. Choosing an overly complex idea will just make the project more difficult and increase the risk of serious errors later.

Seneca | SCHOOL OF SOFTWARE DESIGN & DATA SCIENCE

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

Milestone2: Project Plan Timeline

Chunk down the project into at least three major steps and plan a timeline. Please see https://www.lucidchart.com/blog/8-steps-to-build-a-project-management-timeline for some guidance.

Submit your milestone as a PDF File (recommended, **.pdf**) or Word document (**.docx**) through Blackboard.

Deliverables for Your Project Plan Timeline should include:

In this milestone, you need to fill the following table

Project timeline:

Main components (Briefly <u>explain</u>)	Completion date
1-	
2-	
3-	
Add more rows if needed	

1. A **main sentence** (single sentence) identifying each main component in your project.
2. The expected date to complete each component.
3. Add any more rows.

Some things to keep in mind about this milestone:

- Make sure your project components have a clear task that can be represented using a flowchart or block diagram.
- Review the computer vision topics discussed in class and make sure your components are aligned with the course topics.

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

Milestone3: Project Presentation (Narrated PowerPoint Slide) or (Videorecording) (10% of final grade)

You (per group) will produce a short PowerPoint slide deck explaining your method and key findings of your project. It is important to present your work clearly, clarifying what you have or have not done. Also, it important to end with a ***clear recommendation about what action*** should be taken as a result of your analysis.

You have two options to get the job done:

a) You will then narrate the PowerPoint slides to produce a recorded presentation **between 15 and 20 minutes** long. The PowerPoint file (**.pptx**), with your narration attached, should be submitted using the Blackboard. If you wish, you can save the narrated PowerPoint as a video.

b) Make a video **between 15 and 20 minutes** long to present your work. You can use your screen capture tool with PowerPoint slides to record your presentation or any other tools that get the job done. Submit your video (preferably in **.mp4** format).

Note: This video or PowerPoint file (**.pptx**) will be shared with the class and <u>peer-reviewed</u>.

Here are some tools recommended by Seneca T&L (however, feel free to use any other tool):

[Adobe Spark Video](#)

[Screencast-o-matic](#)

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

Deliverables for Your Project Presentation should include:

- Between 10 and 15 slides.

In your video presentation, include:

- **Problem definition**: Clearly define the problem and **why it is useful**.
- **Related work:** A quick overview of what has been done by others and which one (if any) you are using (code or idea?)
- **What is your contribution**? **What have YOU done?** Please note that installing and running open-source code is not **sufficient**. **You must add some contribution to the work, e.g. new dataset, pre-processing, improving the code, post-processing, evaluation in different conditions, etc. Please include a clear list of items you did. Then, explain each item on the list.**
- An explanation of the Computer Vision components in your implementation, with more focus on your own contribution. In this part, you are teaching everyone what you have learned in the project. Teach your classmates and me something new 😊.
- **Demo**: Show a demo of your project. How well is your code working?
- **Show results and evaluation**. How well is your code working quantitatively (by numbers)? If you started from someone else's code, how much did you improve the results? How much are the results changing when you make the problem more difficult?
- **Reflection**: What did you learn/ experience? Share your experience: what was easy, what was hard, what was fun? Will you continue this project or any parts of it after the course is done?
- A list of references: Please do **NOT** just include the link! Include the title, author, year, etc. See http://libguides.murdoch.edu.au/IEEE/all for examples

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

Some things to keep in mind about this milestone:

- Your narration only needs to be oral. The only thing that needs to be on screen is your slides. You do not need to appear on video in the corner.
- Please avoid transitions or reveals on your slides (i.e. bullet points appearing one after the other, one image being superimposed on top of another, things sliding in from the side). Each slide should appear on its own, in its entirety, while you're talking.
- Remember that people may be viewing your presentation from the back of a room. Make sure everything is **big enough** for people to see.
- Your presentation should be more than you just **reading your slides**. Instead, your slides should be relatively minimalist, showing key images, key ideas or key charts that you then enrich with your oral presentation.
- You can find instructions for how to turn your PowerPoint slides into a narrated presentation from this link , link, and link.

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

Rubric

	Excellent (90-100)	Good (80-89)	Unsatisfactory (less than 80)
Slide Number and Length (20%)	The presentation has 10 to 15 slides, is 10 to 15 minutes long, clearly defines problems, and shows contributions.	The presentation is too short or too long but only by a few slides or minutes. The problem definition and/or contribution are partially discussed.	The presentation is significantly longer or shorter than it should be and/or does not have the required clarification for problem definition and/or contributions.
Images and Charts (25%)	The images and charts used in the presentation clearly illustrate key insights from the student's project and follow the computer vision practices discussed in class. The charts are appropriately sized to be easily read on the slides.	The images and charts illustrate some insights from the student's project and follow most computer vision practices discussed in class.	The images and charts do not illustrate key insights from the student's project and/or do not follow the computer vision practices discussed in class.
Other Visuals and demos (10%)	The other visuals and demos used in the presentation (clip art, photographs) are well chosen and help communicate the presentation's key points or findings.	The other visuals and demos used in the presentation (clip art, photographs) are OK, but there is room for improvement.	The other visuals and demos used in the presentation (clip art, photographs) are not well chosen or are missing altogether.
Results and Evaluation (25%)	The presentation clearly and compellingly presents the results derived from the student's project analysis and makes a clear recommendation with appropriate reflections.	The presentation and results are reasonably clear and compelling but could be made more so. There are no clear reflections.	The presentation and results derived from the student's project are not clear and/or are poorly presented.
Oral presentation (20%)	The oral presentation of the material is clear and engaging. The presenter speaks at a good pace, and key points are made effectively.	The oral presentation of the material is reasonably clear and engaging, but there is some room for improvement.	The oral presentation of the material is ineffective.

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

Milestone4: Writing a Final Report (15%)

Submit your project code and a final report explaining your work as a compressed file (.zip) through Blackboard. Your final project report will be saved as a PDF file (recommended, **.pdf**) or Word document (**.docx**). This milestone will build on your Narrated PowerPoint Slides (the previous milestone), exploring them in greater depth. Make sure that you reviewed the previous milestone requirements.

Deliverables for Your Final Report should include:

1- You will submit your final report (as a PDF) and your code as single ZIP file.

2- **Be between 1,500 and 2,000 words long**.

3- Given its (relatively) short length, your report does not need to include a table of contents, executive summary or bibliography. You can use headings for different sections to make the organization of your report clear (i.e. write "dataset" above the section where you provide your dataset). But think of this milestone as a (relatively) brief analytical report rather than a long, detailed report with multiple parts.

4- Include at least four (and no more than 8) static figures or charts. The charts in your report can include those from previous milestones. Your charts should be sprinkled throughout your report, as close as possible to the text they relate to. This makes it easier for the reader to digest than having all the images or charts at the back, in a "Figures" section. Also, I recommend pulling your flow charts as static images or charts. This will allow you to size them in the best way possible for your report. Also pay attention to the size of your titles and labels: You may want to make them bigger to make them easier to read.

5- **Project Title.** What is the title of your project? What is the problem that you are trying to solve? Please explain. **All authors should be listed directly underneath the title on your report**.

6- **Dataset.** What is the dataset you used? How many images/videos? Please give details and paste a few images/ snapshots here.

7- **Ground Truth.** If applicable, provide details about the Ground Truth (gt). Show samples.

8- **Training vs. Test.** If applicable, explain how you divided your dataset into training and test sets.

9- **Method**. Explain your method and your work. Include your code. Add comments to explain what you did.

10- **Evaluation**.

    a. Please provide sample results (qualitative).

    b. Please provide a performance evaluation of your method (quantitative).

11- **Conclusion:** Write a clear recommendation with appropriate reflections. What did you learn/ experience? Share your experience: what was easy, what was hard, what was fun? Will you continue this project or any parts of it after the course is done?

12- **Reference** at least three outside sources (studies, news articles, reports) that put your project report into context.

13- **Sharing and copyright (Optional).** Please provide a link to your work.

Your project is a good addition to your resume. In addition, it is a good idea to share your work with others. If you wish, make a website, GitHub, Drop Box, OneDrive shared folder, etc. and share your work. Make sure everyone in the group is OK with this and acknowledge all.

Include the following:

a) *Dataset*. If you captured images or videos yourselves.

b) *Ground Truth*. Did you gather ground truth data yourselves? Include the data.

c) Training and Test. Include your training.csv and test.csv.

d) If you used open source/ online code, please provide the links. Any code that was used as a base for projects must be referenced and cited in the body of the report. This includes open-source, or Github implementations. You can use a footnote or full reference/bibliography entry.

e) Your code as a starting point for other future projects.

f) Instructions to using your code. For example, what are the required software installations for your code to work? Which operating system? How to run your code? Include details.

14- **Reference** at least three outside sources (studies, news articles, reports) that put your project report into context.

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

We, ------------ (mention your names), declare that the attached assignment is our own work in accordance with the Seneca Academic Policy. We have not copied any part of this assignment, manually or electronically, from any other source including web sites, unless specified as references. We have not distributed our work to other students.

15- Specify what each member has done towards the completion of this work:

	Name	Task(s)
1		
2		
3		
4		

Mufleh Al-Shatnawi, Ph.D., P.Eng., and Asad Norouzi

Rubric

	Excellent (90-100)	Good (80-89)	Unsatisfactory (less than 80)
Length Requirements (20%)	The report is between 1,500 and 2,000 words and has all the requirements.	The report is too short or too long but only a few hundred words, and/or some requirements are missing.	The report is significantly longer or shorter than it should be, and/or the main requirements are missing.
Writing (20%)	The report is very well-written, with proper grammar, punctuation and spelling.	The report is relatively well-written, with a few grammar, punctuation and spelling errors that do not impede overall understanding.	The report is not well-written, and several grammar, punctuation and spelling errors may disrupt understanding.
Method and evaluation results (20%)	The report clearly explains the methodology and includes experimental results from the student's project.	The report is reasonably clear and does not include enough experimental results but could be made more so.	The report's methodology is unclear, and/or experimental results are poorly presented.
Images and Charts (20%)	The images and charts used in the report clearly illustrate key insights from the student's project and follow the Computer Vision practices discussed in class. The charts are appropriately sized to be easily read within the report	The images and charts illustrate some insights from the student's project and follow most computer vision practices discussed in class.	The images and charts do not illustrate key insights from the student's project and/or do not follow the computer vision practices discussed in class.
Outside References and Sources (20%)	The report refers to at least six outside sources that are well summarized and effectively put the data into additional context.	The outside sources referenced in the report are adequately summarized and put the data in some context, but the sources could have been chosen with more care.	The outside sources referenced in the report do a poor job of putting the data into additional context and/or there are not enough outside sources cited.