ISTD 50.035
Computer Vision

1-D Design Project

Last updated on 15-Sept-2024
(Note that: there is no need to submit poster)

Project Requirements

Working as a team, you are required to propose, design and build a meaningful solution using Computer Vision concepts.

Some project posters from previous years have been made available at the course website. You may want to refer to them to understand the scope and depth of the work.

The team can choose one of the following tracks.

A. Design track

In this track, students are required to apply Computer Vision to address some important problem in our society. The proposed solution should address an open problem under a broad range of themes, including but not limited to: Aging society, security, smart nation, healthcare, urban design, transportation, aviation. Some examples are:

- Aging society: Assist elderly by text recognition (OCR)
- Security: Detect shoplifting by vision-based activity recognition
- Smart nation: Detect emotion of workers to improve productivity

In addition, students can address a problem related their Capstone project. For instance, in the past, vision based object detection has been applied for automated inventory count in a large warehouse.

B. Research track (General)

In this track, students are required to study some research papers, implement the algorithms, perform experiments, and propose improvements on the algorithms, e.g., training algorithm, network architecture. The expectation is that by the end of the project the team has gained reasonable understanding of the selected papers and has performed some related experiments. It is not a requirement to have improved results.

While research papers are the results of dedicated work by industrial / academic researchers and graduate students, some of these ideas could be surprisingly simple and are easy to understand. An important aspect is novelty and out-of-the-box thinking. Some examples:

Masked Autoencoders Are Scalable Vision Learners, CVPR-2022

https://openaccess.thecvf.com/content/CVPR2022/papers/He_Masked_Autoencoders_Are_Scalable_Vision_Learners_CVPR_2022_paper.pdf

mixup: Beyond Empirical Risk Minimization, ICLR-2018

https://openreview.net/forum?id=r1Ddp1-Rb

Prototypical Networks for Few-shot Learning, NIPS-2017

https://papers.nips.cc/paper/6996-prototypical-networks-for-few-shot-learning

Unsupervised Representation Learning by Predicting Image Rotations, ICLR-2018

https://openreview.net/forum?id=S1v4N2l0-

Students can consult the instructor for suggestions of research papers. A lot of computer vision research is published in these conferences: CVPR, ICCV, ECCV, NeurIPS, ICML, ICLR, AAAI (All are A* venues in Computer Science)

C. Competition track

Students are required to work on a Computer vision challenge, propose and implement algorithms for some competition problem.

Example:

https://www.kaggle.com/competitions/ariel-data-challenge-2024/overview

NeurIPS - Ariel Data Challenge 2024

https://www.kaggle.com/competitions/rsna-2023-abdominal-trauma-detection/overview

Abdominal Trauma Detection

https://www.kaggle.com/c/data-science-bowl-2018

Automated cells' nuclei detection and localization

https://www.kaggle.com/c/deepfake-detection-challenge

Identify AI-generated videos

Students will be judged based on the quality and quantity of their efforts. The expectation is that the team can have good understanding of the problem and competition setup, and the team should propose some meaning solution. **The final ranking in the competition is not important**. Therefore, students are encouraged to take part in competitive problems.

Note that it is also ok to work on a closed competition.

Deliverable, Checkoffs, Grading and Rubric

1. **Checkoff-1 [5%]: Team forming, Initial idea**

Students are required to form a team, decide the track and prepare a **0.5 page write-up** for their project: initial project idea, background, and how Computer Vision is relevant.

2. **Checkoff-2 [25%]: Problem Framing, Initial Solution, Project Schedule**

Problem framing: The team needs to explore the design and problem area, context etc. The team needs to frame and define the problem, present the key requirements and constraints that will guide their design. This is an important requirement for the design track.

Initial solution idea: The team shall take the problem and propose some initial solution ideas.

Project schedule: There should be a schedule for further exploration of the idea, implementation of the prototype, schedule and deadline for parts and components ordering, experiments, and testing and debugging.

The team will present these findings in WEEK 6, as well as when meeting with instructors and submitting the slides for further grading.

3. Checkoff-3 [70%]: Final System Prototype and Deliverable

The team should present their final deliverable: prototype, system and experiment results. In most cases, there should be something concrete at the end as the deliverable, not just a paper or theoretical concept. **In particular, it is a requirement to have a working prototype that can solve the intended problem to an extent.**

The team will present these findings in a presentation, and submit a poster for further grading. The team shall also submit the runnable source code, a report to describe the system design and implementation. The report shall include background, approach and system design, experiment results and future work. The report shall also include workload and contribution of each individual team member, and this will be taken into account to compute the grade of each individual.

Grading and Rubric:

Checkoff-2 [25%]: Problem Framing, Initial Solution, Project Schedule

Deliverable / Grading item	Grading criteria	Remark
Problem framing and requirement analysis (10%)	• How well is the description of the area/context/problem/state-of-the-art? • To what extent is the problem clearly and concisely defined based on insightful interpretation and compilation of the background information? • To what extent is the problem exciting and open to new innovations? • How thorough is the analysis of stakeholders' needs and constraints?	
Initial solution (10%)	• How well is the description of the initial hints of design direction and potential solution?	
Project schedule (5%)	• How well is the project schedule organized and up-to-date with realistic milestones? Are the tasks divided into specific activities and assigned to individuals or groups of individuals?	

Checkoff-3 [70%]: Final System Prototype, Deliverable and Experimental results

Deliverable / Grading item	Grading criteria	Remark
Novelty (15%)	• How novel is the proposed solution and system?	
System design and technical strength (30%)	• To what extent does the prototype apply Computer vision concepts and algorithms? • To what extent does the team design and implement computer vision concepts and algorithms	
Experiment and evaluation (15%)	• To what extent does the team evaluate appropriate computer vision algorithms for their problems?	

Report (10%)	• Is the report well written, well structured, concise and clear? • Please discuss how your work contributes to UN's Sustainable Development Goals: https://sdgs.un.org/goals	
Items checklist	• Presentation slides • Runnable source code • Experiment results • Report	

Please note the policy on using Large Language Model (LLM) in your report writing: In the report it is not acceptable to use text produced entirely by LLMs (i.e., "generated"). However, it is ok to use LLMs for editing or polishing author-written text. **Please include a section in your report to mention any use of LLM in your report writing.**

As in past years, bonus could be given for outstanding course projects.