COS791 Project Information Pack

The module project allows you to research and apply computer vision techniques to a problem of interest. Potential projects usually fall into three tracks:
1. Application/Model-replication involves picking a real-world problem and applying a computer vision model to solve it. You can apply an algorithm or variant not used on that problem to tackle vision tasks. Select a topic from the table below (1-14). The task is to replicate the referenced paper with the tasked algorithm.
2. Survey - This entails conducting a systematic literature review. Unlike traditional literature reviews, which often rely on a subjective selection of studies, systematic reviews follow a predefined protocol to ensure objectivity and replicability. By following the steps outlined in a protocol, systematic reviews provide a reliable and evidence-based summary of the available research on a particular computer vision topic.

1. **Option One:** Research Project.
    - Introduction.
    - Literature review.
    - Proposed method and analysis.
    - Experiment.
    - Results.
    - Conclusion.
    - Appendix - Member's contributions.
    - Reference.

    Guidelines: Project
    - Select a topic. You can work in groups(max of 4).
    - Each member must have a specific task.
    - One combined pre-recorded presentation in MP4 format.
    - Evaluation- written report (be clear, complete, correct, etc.), code (be clear, complete, correct, etc.) and oral/recorded presentation.
2. **Option Two:** Systematic Literature Review
    - Select a topic (16-21).
    - How to conduct an SLR (PICOC or PRISMA) is outlined in [1, 18]. Examples are shown in [11, 8].
    - Conduct the review.
    - Submit a report.

	Title
1	Neural Architecture Search using Adaptive Differential Evolution for Medical Imaging Segmentation[22].
2	Automated Design of Deep Networks for Retinal vessel Segmentation using Grammatical Evolution [21].
3	Reinforcement Learning Searching and Pruning of Deep Neural Networks for Medical Imaging Diagnostic [5].
4	Automated Design of CNN Architectures using Grammatical Evolution for Image Classification. [20].
5	Feature selection using Genetic Programming for Hyperspectral image classification[14].
6	Optimisation of a Genetic Algorithm for Multilevel Thresholding of Medical Images using a Neighbourhood Search [17].
7	Adaptive Differential Evolution for NAS for Brain Vessel Segmentation [12].
8	Optimisation of Artificial Bee Colony for MLT Segmentation.[23].
9	Comparison of Genetic Programming vs Grammatical Evolution for Convolutional Neural Network Architecture Search [24].
10	Comparison of Linear GP to Standard GP for NAS for Medical Imaging [6].
11	Learning-Based Single Image Dehazing via Dynamic Genetic Programming[13].
12	Automated Design of SIFT for Facial Recognition [16].
13	Comparative analysis of Linear GP to Tree-Based GP for the Automated Design of CNN [9].
14	Neural Architecture Search of Convolutional Neural Network for Facial recognition using Grammatical Evolution [2].
15	White ball tracking for the Visually Impaired. The task is to track and enhance the visibility of the ball in the provided video snippets. The videos can be slowed down to a reasonable speed.
16	Neural Architecture Search for Image Classification using Genetic Algorithms: Systematic Literature Review [15].
17	Genetic Algorithms for Object Detection: A Systematic Literature Review [10].
18	Image Feature Extraction using Genetic Programming: A Systematic Literature Review [4].
19	Hybrid evolutionary algorithms for Image Segmentation: A Systematic Literature Review [7].
20	Medical image segmentation using Differential Evolution: A Systematic Literature Review [3].
21	Image Dehazing using Evolutional Algorithms: A Systematic Literature Review [19].

The accompanying reference paper for each topic is there to provide a guideline

and comparative analysis. You will need to use the same data as in the reference paper unless if specifically not feasible.

Option 3. Object Tracking (15)

The use of a complete commercial tool is not permitted for this option. Two videos are provided.

Design an image processing approach to track a field hockey ball in a video and enlarge it to make it more visible. The algorithm should be able to handle variations in lighting conditions, camera angles, and ball colours. The following tasks need to be met.

1. Identify the ball in each frame of the video. Consider the challenges of varying lighting conditions, ball colours, and potential occlusions.
2. Ability to track and to maintain the ball's (puck) position across consecutive frames. Address potential issues like ball loss or false positives.
3. Create a mechanism to enlarge and change the colour of the detected ball region in each frame.
4. The following are to be submitted.
    - A detailed report describing your algorithm, implementation, and evaluation.
    - The source code of your implementation.
    - A video demonstration of your algorithm applied to the provided videos.

Once a topic has been selected and a group constituted I should be emailed by the group coordinator notifying me of membership and topic selected.

If you need additional computational resources you can create a ticket to request access to the MITC cluster on the CS Portal.

If you need further clarification a meeting with the group can be arranged.

References

[1] Carrera-Rivera, A., Ochoa, W., Larrinaga, F., Lasa, G.: How-to conduct a systematic literature review: A quick guide for computer science research. MethodsX **9**, 101895 (2022)

[2] Coşkun, M., Uçar, A., Yildirim, Ö., Demir, Y.: Face recognition based on convolutional neural network. In: 2017 international conference on modern electrical and energy systems (MEES). pp. 376–379. IEEE (2017)

[3] Damas, S., Cordón, O., Santamaría, J.: Medical image registration using evolutionary computation: An experimental survey. IEEE Computational Intelligence Magazine **6**(4), 26–42 (2011)

[4] Ding, S., Zhu, H., Jia, W., Su, C.: A survey on feature extraction for pattern recognition. Artificial Intelligence Review **37**, 169–180 (2012)

[5] Fernandes, F.E., Yen, G.G.: Automatic searching and pruning of deep neural networks for medical imaging diagnostic. IEEE Transactions on Neural Networks and Learning Systems **32**(12), 5664–5674 (2020)

[6] Fuentes-Tomás, J.A., Mezura-Montes, E., Acosta-Mesa, H.G., Márquez-Grajales, A.: Tree-based codification in neural architecture search for medical image segmentation. IEEE Transactions on Evolutionary Computation (2024)

[7] Grosan, C., Abraham, A.: Hybrid evolutionary algorithms: methodologies, architectures, and reviews. In: Hybrid evolutionary algorithms, pp. 1–17. Springer (2007)

[8] Harie, Y., Gautam, B.P., Wasaki, K.: Computer vision techniques for growth prediction: A prisma-based systematic literature review. Applied Sciences **13**(9), 5335 (2023)

[9] Kapoor, R., Pillay, N.: A genetic programming approach to the automated design of cnn models for image classification and video shorts creation. Genetic Programming and Evolvable Machines **25**(1), 10 (2024)

[10] Kaushal, M., Khehra, B.S., Sharma, A.: Soft computing based object detection and tracking approaches: State-of-the-art survey. Applied Soft Computing **70**, 423–464 (2018)

[11] Kitchenham, B., Brereton, O.P., Budgen, D., Turner, M., Bailey, J., Linkman, S.: Systematic literature reviews in software engineering–a systematic literature review. Information and software technology **51**(1), 7–15 (2009)

[12] Kuş, Z., Kiraz, B., Göksu, T.K., Aydın, M., Özkan, E., Vural, A., Kiraz, A., Can, B.: Differential evolution-based neural architecture search for brain vessel segmentation. Engineering Science and Technology, an International Journal **46**, 101502 (2023)

[13] Lee, C., Shao, L.: Learning-based single image dehazing via genetic programming. In: 2016 23rd International Conference on Pattern Recognition (ICPR). pp. 745–750. IEEE (2016)

[14] Li, S., Wu, H., Wan, D., Zhu, J.: An effective feature selection method for hyperspectral image classification based on genetic algorithm and support vector machine. Knowledge-Based Systems **24**(1), 40–48 (2011)

[15] Liu, Y., Sun, Y., Xue, B., Zhang, M., Yen, G.G., Tan, K.C.: A survey on evolutionary neural architecture search. IEEE transactions on neural networks and learning systems **34**(2), 550–570 (2021)

[16] Luo, J., Ma, Y., Takikawa, E., Lao, S., Kawade, M., Lu, B.L.: Person-specific sift features for face recognition. In: 2007 IEEE International Conference on Acoustics, Speech and Signal Processing-ICASSP'07. vol. 2, pp. II–593. IEEE (2007)

[17] Manikandan, S., Ramar, K., Iruthayarajan, M.W., Srinivasagan, K.: Multilevel thresholding for segmentation of medical brain images using real coded genetic algorithm. Measurement **47**, 558–568 (2014)

[18] Riaz, M., Sulayman, M., Salleh, N., Mendes, E.: Experiences conducting systematic reviews from novices' perspective. In: 14th International Conference on Evaluation and Assessment in Software Engineering (EASE). BCS Learning & Development (2010)

[19] Singh, D., Kumar, V.: A comprehensive review of computational dehazing techniques. Archives of Computational Methods in Engineering **26**(5), 1395–1413 (2019)

[20] Sun, Y., Xue, B., Zhang, M., Yen, G.G., Lv, J.: Automatically designing cnn architectures using the genetic algorithm for image classification. IEEE transactions on cybernetics **50**(9), 3840–3854 (2020)

[21] Wei, J., Zhu, G., Fan, Z., Liu, J., Rong, Y., Mo, J., Li, W., Chen, X.: Genetic u-net: automatically designed deep networks for retinal vessel segmentation using a genetic algorithm. IEEE Transactions on Medical Imaging **41**(2), 292–307 (2021)

[22] Yu, C., Wang, Y., Tang, C., Feng, W., Lv, J.: Eu-net: Automatic u-net neural architecture search with differential evolutionary algorithm for medical image segmentation. Computers in Biology and Medicine **167**, 107579 (2023)

[23] Zhang, Z., Yin, J.: Bee foraging algorithm based multi-level thresholding for image segmentation. Ieee Access **8**, 16269–16280 (2020)

[24] Zhu, Y., Yao, Y., Wu, Z., Chen, Y., Li, G., Hu, H., Xu, Y.: Gp-cnas: Convolutional neural network architecture search with genetic programming. arXiv preprint arXiv:1812.07611 (2018)