

Requirements for the Final Report

– With solutions

Instructions:

1) Submission:

Two items:

- Upload your Final Report: **Submission by Canvas** – The report PDF is uploaded on Canvas LMS with filename –“DeepSeaNet Improving Underwater Object Detection using EfficientDet [final_report].pdf”
- Code and instructions to run and test: **Email to me** (ksripon@hiof.no) – A supplementary material “instructions_for_code.pdf” will be attached to run the code and send via email, while a GitHub link is present in conclusion of the report.

2) Deadline (**both Final Report and Code**) : May 5, 2023, until 17:00 (Norwegian Time)

✓Acknowledged

3) Your submission will be atomically checked for plagiarism. In case of any plagiarism, it will be handled by Østfold University College’s policy. You can find more about it at <https://www.hiof.no/english/studies/examinations/cheating-and-plagiarism/>

✓Acknowledged

Requirements:

1) Your final report must have a word count between 5500 and 7500 words, excluding references.

➔ **Current total word count of all text (as shown in MS word 2023 v16.72) = 8367**

8367 words (screenshot from word)

➔ **Current word count of references (as shown in MS word 2023 v16.72) = 860**

860 of 8367 words (screenshot from word)

➔ **Current word count of main text without references (calculated) = 8367-860 = 7507**

2) You do not need to include your code within the report itself. Instead, send your code and instructions on how to run and test by email to me.

➔ **✓Acknowledged. Code is available on GitHub URL -**

<https://github.com/s4nyam/efficientdet-advml>, this is the same URL that is also present in the conclusion of final report. While a supplementary material is prepared to run the code easily and smoothly on Google Colab / AWS SageMaker (wherever required)

- 3) The report should be written at an “**Advanced**” level, providing enough detail for someone with a good ML background but who may not be familiar with the chosen technique and application. After reading your report, the reader should be able to become an expert on your chosen algorithm and technique; and successfully replicate your work. The report should provide sufficient information on the advantages, disadvantages, implementation, analysis, and application of the technique.

➔ **✓Acknowledged. The report (or drafted journal paper) expects the reader to have basic knowledge of following topics (however, I have tried to be brief wherever necessary to explain it):**

- **Underwater and Marine life research, existence of different types of objects that can exist in deep inside the sea.**
- **Convolutional Neural Networks (CNN), a familiarity with basics of backpropagation - weight update rule, nonlinearity by activation functions, feature maps**
- **Statistics, mean, standard deviation, variance, gradient descent.**
- **At implementation side it is expected to have hands on experience with Amazon Sagemaker and Google Colab runtime environments and how to run python notebooks.**

- 4) In summary, the report should cover all the points outlined below.

Point-1:

The report should present a detailed analysis of your selected machine learning technique/algorithm, aiming to achieve a comprehensive understanding. The following points should be covered (at a minimum):

- 1) Introduce the technique/algorithm you have chosen.
➔ A good detail about One Stage Object Detectors exist in Introduction section 2 of the report. A short details about YOLO, EfficientDet and proposed EfficientDet is also provided in Introduction section 2.
- 2) Describe why the technique/algorithm is unique or noteworthy.
➔ This is also mentioned in the same section 2, paragraph 4 (in 4th line). Exact words starts with : “*EfficientDet is known for balancing the speed vs accuracy tradeoff and cheap parameter space*” and so on...
- 3) Compare and contrast it with other similar techniques/algorithms, using practical examples where possible.
➔ Section 2 present A short brief of contrastive study is present in introduction where comparison has been made between Two Stage Object Detection and One Stage Object Detection along with multiple types of OSOD.

➔ Section 6, covers a result based comparative analysis of the proposed approach with using same algorithm on other applications and same application with other algorithms. A whole new experiment has been done in required cases where different algorithms have been implemented on my chosen application and hence the results were compared. In simpler words, I have reproduced the related algorithms (which are mentioned in related work, section 3) on my chosen application (dataset) and compared. In addition, wherever my chosen application is used, I have also reproduced results on other algorithms. Therefore, presenting results in Table 5, Table 6, Figure 8, Figure 9, Figure 10, Figure 11.

- 4) Discuss the working principle of the technique/algorithm, including its working flow, equations, and analysis.

➔ The discussion starts from section 4 (Proposed Methodology), a detailed explanation of working principle of the technique/algorithm is present in section 4.2 where backbone (4.2.1), neck (4.2.2) and head (4.2.3) are explained. A concise diagram for working flow is provided with Figure 1 and algorithms 3,4 and 5 shows equations and analysis.

- 5) Evaluate its advantages and disadvantages.

➔ Results and Discussion (section 6) evaluates about proposed approach, compare and provides explanation using Figures 10 and 11 to prove model is trained well and able to rationalize class specific features as part of advantages, however, except high computational resources required to train the model, there does not seem any disadvantages for the proposed approach (as can be seen in Table 4 left side).

- 6) Explore its various applications, providing a justification for why your chosen technique/algorithm is more suitable for this particular type of application(s) than other similar existing machine learning techniques/algorithms.

➔ various applications for the proposed algorithm are discussed in related work (section 3) and Table 1. After reviewing such drawbacks in related works, proposed method uses BiSkFPN to make feature fusion robust to perturbations and naturally occurring adversarial noises in such murky conditions (such as my chosen application of underwater object detection)

Point-2:

The report must contain adequate information about your chosen application, covering the following points at minimum:

- 1) Provide a detailed description of your chosen application.
 - ➔ Section 2 initial paragraph provides a quick overview about chosen application by describing AMODMV.
 - ➔ Section 4.1 explains a lot more details about chosen application and the dataset.
- 2) Identify the challenges associated with the application.
 - ➔ Section 2 second paragraph gives detail about challenges and difficulties of such complex application / AMODMV.
- 3) Justify why your selected technique/algorithm is appropriate for handling the application.
 - ➔ Section 2
 - ➔ By providing GradCAM explanations and robustness to adversarial noise increases interpretability of proposed EfficientDet architecture (sections 4.2.4, 4.2.5, figure 10, figure 11.
 - ➔ In fact a multi-level experimentation is done. Initially comparing YOLOv3, v4, v5, v8, Detectron2 and proposed approach with training and testing accuracy. Further class-wise accuracy is tested (Tables 5,6 Figures 8,9,10,11). And then best two models (YOLOv8 and Proposed EfficientDet) is chosen to see box plots of both the models and it can be easily seen in Figure 8 that proposed EfficientDet is doing well than YOLOv8). YOLOv8 can be seen with less box plots than EfficientDet (which are predicted with high accuracy and correctly).
 - ➔ This was confirmed by looking at GradCAM visuals on Figure 11.
 - ➔ Further proposed approach is made more robust by adversarial learning. (Figure 10)
- 4) Explore other potential techniques/algorithms that can be used to handle the application.
 - ➔ As mentioned in Answer 3, potential applications are explored rigorously. YOLOv3, v4, v5, v8, Detectron2.
- 5) Explain why you believe that the technique/algorithm you have selected is superior to other alternatives for addressing the application.
 - ➔ Testing accuracy, robustness to perturbed images, adversarial learning, better explanations, more predictions in multi-label multi-class environment.

Point-3:

This point pertains to the approved articles (minimum of four), with the following minimum points to be addressed:

- 1) Enumerate the articles and provide a rationale for selecting them. The justification can be based on either the selected technique/algorithm or the selected application.
 - ➔ Five articles are chosen where, one article contains my chosen application with baseline. However, four articles are chosen where other techniques are utilized for other applications. A great detail oriented explanation is provided in section 3 with five sub sections (related work 3.1, 3.2, 3.3, 3.4, 3.5).

→ Rationale behind selecting them is mentioned in first few sentences of the sub sections 3.1 to 3.5 for respective articles.

→ Justification is provided on the basis of either by my matched application or my interest in techniques/algorithm used (mainly YOLO, RCNN, EfficientDet).

2) For each article:

- a) State the objectives of the article.
- b) Explain its working principle or methodology.
- c) Describe the results or achievements obtained.
- d) List the advantages and disadvantages.

→ Great details are provided in section 3 for each of the points mentioned for every major chosen article (reference) along with Table 1

Point-4:

Your report's final section should include a detailed explanation of your implementation process, as well as an advanced level comparison and analysis of the results you achieved. The following items should be included at a minimum:

1) Describing your implementation in detail so that others can replicate your work.

→ Section 5 and Table 4 has details about experimental setup.

→ And supplementary GitHub repository is also provided as a hyperlink in conclusion section where stepwise procedure is provided to run all experiments.

→ Another supplementary PDF is attached with final report to provide same stepwise explanation to run experiments.

→ Considering word limits, and redundancy aspects, only key information are provided in final report for experimental setup.

2) Mention, analyze and describe your results. This includes:

- a) Providing justifications for why you obtained such results, whether they were positive or negative.

→ Section 6 last paragraph discusses justifications and reasons for the obtained results. Technical explanations and algorithmic interpretations are provided in figures 8, 10 and 11.

- b) Comparing your results to other results achieved using similar techniques or algorithms on the same application.

- i) If the results you use for comparison were not obtained from the same articles you chose, you should provide proper references to the source articles from which you obtained the comparison results.

→ Figure 9 legend box provides citations of the techniques on which I reproduced the results for my chosen application. (YOLOv5,v8, Detectron2), so the results are obtained from the techniques mentioned in the citations. However it was important to cite them because the references uses very close applications to my chosen application.

→ Figure 9 legend box also provides citations of the techniques on which I obtained direct results as part of baselines. (YOLOv3 and v4)

ii) It's important to note that if you are implementing your chosen technique on a new practical application, we can individually discuss the type of comparison and analysis that you should include in your final report.

→ I am using my proposed technique and techniques proposed in chosen articles for chosen application to compare on same base.

3) When describing the required analysis/comparison, it's essential to aim for an "**Advanced**" level. This means that simply comparing achieved results is not enough; you must justify why your results are better or worse than the comparison results. If your achieved results are worse than the comparing results, you must also include your thoughts on how to improve them.

→ All required details are provided in "results and discussion" section with informative plots and visualisations.