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Dr. Nassereddine Rikli
Editor-in-Chief
Journal of King Saud University Computer and Information Sciences

December 31, 2020

Dear Dr. Rikli:

I am pleased to submit an original research article entitled "Multi-Level Residual Network VGGNet for Fish Species Classification" by Nanik Suciati, Chastine Fatichah, and My Name for consideration for publication in the Journal of King Saud University Computer and Information Sciences. We previously uncovered a role for Multi-Level Residual (MLR), as a new residual network strategy, by combining low-level features of the initial block with high-level features of the last block of CNN by applying depthwise separable convolution (DSC), and this manuscript builds on the study to classify fish species using MLR-VGGNet inherited from VGGNet and strengthened it using asymmetric convolution (AC), MLR, batch normalization (BN), and residual features with higher performance.

We believe that this manuscript is appropriate for publication in the Journal of King Saud University Computer and Information Sciences because it is related to aspects of both foundations of computer and its practical applications, especially in Computer Vision. Our manuscript creates a paradigm for future studies of the new residual network strategy of CNN for completing fish species classification

This manuscript has not been published and is not under consideration for publication elsewhere. We also have no conflicts of interest to disclose.

Thank you for your consideration!

Sincerely,

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Multi-Level Residual Network VGGNet for Fish Species Classification

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We thank the Research and Community Service Directorate (DRPM) DIKTI Indonesia for supporting the research of authors.

Declaration of interests
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

(JKSUCIS-D-21-00003) Response Letter:

Title: Multi-Level Residual Network VGGNet for Fish Species Classification.

Reviewer #1 comment to the authors:

[0] The author does not mention which programming language they have used to implements these classification models. It is also needed to compare these model in terms of execution times.

Answer:
Thank you for your valuable comment.

1. We experimented using Python in Google Colaboratory with Tensorflow 2.3.0 and Keras 2.4.3; during training, we used a Tesla T4 GPU with 16 GB of memory provided by Colab. We also use pre-trained CNN comparisons from Keras Application, including VGGNet, Inception V3, ResNet50, and Xception
   (For this answer, I give explaining in section 4.3 and 4.4, line 346-359 …….. red font).

2. For your comment "compare these model in terms of execution times", I experimented by executing a classification of 649 images without GPU and then calculating the average in ms.
   (For this answer, I provide an explanation of the results and analysis in section 4.7, line 416-427 ……. red font).

Reviewer #1 comment to the authors:

[1] In the line 32 (Labao & Naval, 2019) may be written Labao & Naval (2019). Similar modifications of the citations of the references are needed in the papers.

Answer:
Thank you for your valuable comment.

1. The citation in line 30 was corrected by rewriting the sentence to fit the citation style of the journal (red font).
2. For your comment "Similar modifications of the citations", I have corrected the problems such in line 31, 45, 49, 125, 126, 127, 128, 130, 137, 141, 142, 175, 335 were corrected to to fit the citation style of the journal (red font)

Reviewer #1 comment to the authors:

[2] In line 35 the citation of the references should be use the APA format.

Answer:

Thank you for your valuable comment.

1. In line 33, the citation of the reference have corrected to APA format (red font)
2. The similar citation problem such as in line 104, 139 were corrected to APA format (red font)

Reviewer #1 comment to the authors:

[3] Figure number at page 11, 13 are incorrect that is to be corrected in caption of the figures and its references.

Answer:
Thank you for your valuable comment.

1. Figure at page 11 (or page 10 in my revision version) is written Fig. 3…… should be Fig. 4, and I have corrected to Fig. 4 and so its references, line 255 (….. red font)
2. Figure at page 13 (or page 12 in my revision version) is written Fig. 3…… should be Fig. 5, and I have corrected to Fig. 5 and so its references, line 289 (….. red font)

Reviewer #1 comment to the authors:

[4] In page 14 the figure number is incorrect, and at line number 309 the reference of the figure number is incorrect.

Answer:
Thank you for your valuable comment.

1. Figure number at page 14 (or page 13 in my revision version) is written Fig. 4……. Should be Fig. 6, and I have corrected to Fig. 6 and so its references such as line 325 (….. red font).
2. At line 309 (line 325 in my revision version) the reference of the figure number is written Figure 1…….. should be Fig. 6 as the references to Fig. 6, line 325 (….. red font).

Reviewer #1 comment to the authors:

[5] At page 18, the table number is table 3. And at the reference of this table it is incorrect at line 404.

Answer:
Thank you for your valuable comment.

1. Yes right, at page 18 (submission version), the table number is table 3. However, to reduce the contents (to 20 pages), I combined the table 3 and table 1, and so its references such as line 395 refers to table 1 (….. red font)
2. Line 404 (line 406 in my revision version) is written as reference of Table 2. As reducing the contents, now it stays as the reference of table 2 (….. red font)

Reviewer #1 comment to the authors:

[6] At line 427, at the place of Fish-gres there is Fish-new.

Answer:
Thank you for your valuable comment.

1. Line 427 (line 440 in my revision version) is written Fish-new…… I have corrected to Fish-gres (….. red font)

Reviewer #2 comment to the authors:

[1] In the abstract, the authors should write about obtained results and their impact on other existing solutions.

Answer:
Thank you for your valuable comment.

1. In the abstract, I have added obtained results and the impact on other existing solutions, where our proposal achieved an accuracy of 99.69%, outperformed original VGGNet relative up to 10.33% and other CNN models relative up to 5.24% on Fish-gres and Fish4-Knowledge dataset (……..red font in abstract)

Reviewer #2 comment to the authors:

[2] The introduction section should be extended to analyze more neural network solutions which could be used in the comparison section like some new solutions in CNNs and its hybridization like adaptive genetic algorithm with a convolutional neural network, or even about the application of convolutional networks and learning transfer, for instance in strengthening the perception of the virtual worlds in virtual reality.

Answer:
Thank you for your valuable comment.

1. In the introduction section, we have enhanced it with literature studies related to "some new solutions in CNNs" and transfer learning such as crystal graph convolutional neural network (CGCNN) (Lee and Asahi, 2021); Alzheimer's disease classification on MRI using transfer learning from the LeNet-like model (Aderghal et al., 2020); geochemical anomaly detection using transfer learning (Li et al., 2020); crack detection using transfer learning on pre-trained CNN (Yang et al., 2020). (We add these literature studies on the line 51-55 …..... red font)
2. For your comment “hybridization like adaptive genetic algorithm with a convolutional neural network”, we enhanced literature studies with several journals such as combination of CNN and Genetic Algorithm (GA) (Kabir Anaraki et al., 2019); combination of GA and CNN to generate a

model that performs better than transfer learning (Połap, 2020); GA is also used to determine the best-combined weight of the three CNN models to achieve more optimal performance (Ayan et al., 2020), and also to initialize CNN weights so that they converge more quickly (Ijjina and Chalavadi, 2016). (We add these literature studies on the line 56-64 ….. red font)

Reviewer #2 comment to the authors:

[3] add some visualization of your proposal with some sample examples.

Answer:
Thank you for your valuable comment.

1. We present some visualization of my proposal with some sample examples by showing the results of the classification of fish species images and also comparing them with several other models. We show several images where our proposal is more robust in classifying fish species than other models. (We add this explanation in the section 4.6, line 377-392 …….. red font)

Reviewer #2 comment to the authors:

[4] More theoretical justification for using these tools is really needed.

Answer:
Thank you for your valuable comment.

There are some theoretical justification for using these tools in our manuscript as follows:

1. VGGNet became a model that has been developed by numerous other researchers for various purposes, including classification and object detection. However, VGGNet used a vast number of parameters with a performance already outperforming other newer models. Reducing the number of parameters by eliminating the final convolution block (the fifth block) is beneficial since newer CNN models usually use a more significant number of parameters to produce better results. We also use pre-trained VGGNet as initial weights to speed up training computation and inherit low-level features that have been created during training with the imagenet dataset. We also use pre-trained VGGNet as weights to reduce training time and inherit the low-level features generated during training with the imagenet dataset.
2. A convolutional layer with kernel size 3×3, input 32 feature map, and output 32 feature map, then the number network connection or parameters are $(3\times3\times32+1)\times32=9.248$ parameters. The AC reduces the number of parameters by filter 3×1 with $(3\times1\times32+1)\times32=3.104$ parameters followed by filter 1x3 with $(1\times3\times32+1)\times32=3.104$ parameters. The total number of parameters would be 6,208 parameters, and the reduction is 33%. This theoretical calculation example proves that AC reduces the parameters of the CNN
3. The use of residual blocks is motivated by the fact that the identity mapping from one layer to the next is asymptotically equivalent to using several nonlinear layers to estimate a complicated function (He et al., 2016). Therefore, integrating residual blocks into our proposed model would

boost the system's ability to handle complex functions and generate high-level features. As stated by the formula above, there is an identity mapping in the next layer after feature map F.

4. The use of three times AC in the new block can induce an internal covariate shift; as the training data and layers increase, the gradient generated by the activation function gets closer to zero (Ioffe and Szegedy, 2015). As a result, the training carried out also took longer. We added BN at the end of each 3 × 1 and 1 × 3 kernel pair convolution to prevent internal covariate shifts and speed up the training process.
5. In MobileNet, DSC is used as the key component of the convolution to achieve tiny models with comparable performance to standard convolution (Howard et al., 2017). It consumes less computational resources due to its small size. DSC is an excellent choice for adjusting the lower and upper layers' feature maps with minimal computation costs to realize MLR in our proposal. To support the MLR-VGGNet model's development, we only need one time DSC (one-time deep-wise convolution and one-time pointwise convolution).
6. Due to cascading convolution, the final layer only produces high-level features. Although ResNet also proposes a residue (skip connection) to maintain low-level features that might be lost due to higher-level convolutions, the residual delivery does not reach final layers (He et al., 2016). Densenet also adds residues with concatenation and pointwise convolution, but the delivery of residues ends in the same block, meaning that the CNN has not maintained the initial block's low-level features until the final block (Huang et al., 2017). Therefore, we incorporate the low-level features at the end of the VGGNet convolution block using skip connection through one-time DSC for joining the low- and high-level features.

All of the theoretical justifications are described in the section 3.1 line 162-172, section 3.2 line 183-188, section 3.3 line 203-207, section 3.3 line 215-218, section 3.4 line 232-236, section 3.5 line 243-249 ……. red font

Reviewer #2 comment to the authors:

[5] How did you choose this architecture proposed in Fig. 1?

Answer:
Thank you for your valuable comment.

1. After winning the ILSVRC, VGGNet has become a prevalent model and has been developed by numerous researchers for various purposes, including classification and object detection. However, VGGNet performance was already outperforming other newer models, therefore in this research, we improved VGGNet with fewer parameters and achieved superior performance than newer models. Reducing the number of parameters is beneficial since newer CNN models usually use a more significant number of parameters to produce better results. Hence, to diminish the number of parameters, the best approach is eliminating the final convolution block (the fifth block) since this block generates high-level features while keeping the previous block. We also use pre-trained VGGNet as initial weights to speed up training computation and inherit low-level features that have been created during training with the imagenet dataset. Meanwhile, we freeze the four blocks during training to keep the weights and preserve the layers' generalization.

(We add this explanation in the section 3.1, line 162-172 …….. red font)

Reviewer #2 comment to the authors:

[6] How did you train a model? Add some more information about it.

Answer:
Thank you for your valuable comment.

1. The performance of the proposed MLR-VGGNet was proven by a comparison on various CNN models, such as the original VGG16, VGG19, ResNet50, Inception V3, and Xception. In all comparison models, a transfer learning from pre-trained weights available was also used. The training parameters on all models is given, such as batch size = 20, epoch = 60, optimizer = RMSProp, learning rate = 1e-5, loss function = categorical cross-entropy.
   (We add this explanation in the section 4.4, line 351-355 …….. red font)

Reviewer #2 comment to the authors:

[7] Did you tested freezing layers?

Answer:
Thank you for your valuable comment.

1. During training, the four blocks of VGGNet were frozen; therefore, the weights did not change to retain the lower layers generalized to generate low-level features. Additional components such as AC, BN, and residuals are fully trained to achieve weight with high-level feature generation that corresponds to the fish species classification.
   (We add this explanation in the section 4.4, line 356-359 …….. red font)

Reviewer #2 comment to the authors:

[8] A pseudo-doe would be nice to see.

Answer:
Thank you for your valuable comment.

1. This CNN classification of fish species uses a whole image as input; then, it is processed using MLR-VGGNet to obtain the feature maps. The class labels are obtained by classifying feature maps using the fully connected layer. The pseudo-code for the MLR-VGGNet model can be seen in Fig. 5.
   (We add the pseudo-code in the section 3.6, line 297-305 …….. red font)

Reviewer #2 comment to the authors:

[9] Why VGG, and not Inception, AlexNet, etc?

Answer:
Thank you for your valuable comment.

1. VGGNet has succeeded in simplifying the AlexNet architecture by using smaller convolutional kernel sizes, but VGGNet still uses a vast number of parameters and its performance has been outperformed by newer models. Reducing the number of parameters by removing the fifth block is beneficial since newer CNN models usually use a more significant number of parameters to produce better performance.
   (We add this explanation in the section 1, line 75-79 …….. red font)

Ubhara Surabaya

Eko Prasetyo <eko@ubhara.ac.id>

Decision on submission to Journal of King Saud University - Computer and Information Sciences

1 message

Journal of King Saud University - Computer and Information Sciences <em@editorialmanager.com> 29 May 2021 at 23:29
Reply-To: Journal of King Saud University - Computer and Information Sciences <jksu-cis@elsevier.com>
To: Eko Prasetyo <eko@ubhara.ac.id>

Manuscript Number: JKSUCIS-D-21-00003R1

Multi-Level Residual Network VGGNet for Fish Species Classification

Dear Mr. Prasetyo,

Thank you for submitting your manuscript to Journal of King Saud University - Computer and Information Sciences.

I am pleased to inform you that your manuscript has been accepted for publication.

My comments, and any reviewer comments, are below.
Your accepted manuscript will now be transferred to our production department. We will create a proof which you will be asked to check, and you will also be asked to complete a number of online forms required for publication. If we need additional information from you during the production process, we will contact you directly.

We appreciate you submitting your manuscript to Journal of King Saud University - Computer and Information Sciences and hope you will consider us again for future submissions.

Kind regards,
Nasser-Eddine Rikli
Editor-in-Chief

Journal of King Saud University - Computer and Information Sciences

Editor and Reviewer comments:

Reviewer #1: In this paper the author proposed Multi-Level Residual (MLR) Networks and MLR-VGGNet for fish classification using their images and video. They claims that their proposed classification model are also able to capture low-level features such as points, lines, and textures for representing edge spines, gill covers, fins, and skin textures in order to achieve higher performance. They reported that their proposed model MLR-VGGNet achieved an accuracy of 99.69%, which outperformed original VGGNet relative up to 10.33% and other CNN models relative up to 5.24% on Fish-gres and Fish4-Knowledge dataset.

Reviewer #2: All my comments have been correctly addressed.

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