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## Optimized EfficientNetB3 Architecture for High-Precision Multi-Class Weather Condition Classification

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### Abstract.

Most various industries, disaster management being one of them, transport and agriculture in particular, require meteorological conditions to be properly rated in the correct and appropriate manner, i.e. clouds, rain shine, and sunrise. This paper concentrates on the EfficientNetB3 model which is characterized by performance as well as computing efficiency, and hence deep learning is used to advance the classification of weather conditions. Optimizing the EfficientNetB3 design we arrive at an outraging 97% classification accuracy.

**Keywords.** EfficientNetB3, weather condition classification, deep learning,

### 1. INTRODUCTION

Weather classification Accurate and quick classification of weather conditions is essential in numerous industries, one of them being disaster management, transportation, and agriculture. Early detection and identification of weather changes like clouds, rain, shine and sunrise are meant enhance decision making through enhanced knowledge about the changes and consequently reduces the risks associated with the sudden changes in weather. The farmers ought to plant as much as they can and the officials involved in transportation ought

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to enhance safety measures to prevent accidents caused by unfavorable climatic conditions [1-3].

## 2. INPUT DATASET

The dataset utilized in the present research presented in Fig. 1 was obtained on the open-source Kaggle site and is dedicated to the four weather conditions such as cloudy, rainy, sunny, and sunrise. It contains 1,125 high quality and diversified images, which have been carefully partitioned into training, validation and testing to facilitate the development and testing of a strong model. The training pool consists of 900 images, which gives a broad variety of situations to increase the learning ability of the EfficientNetB3 model.

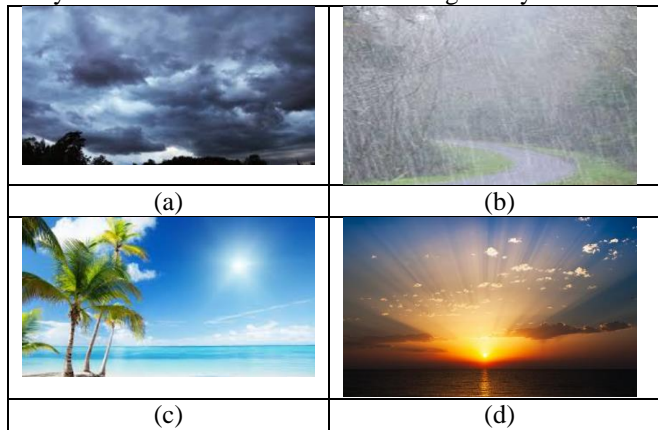


Fig. 1 Dataset image for (a) Cloudy (b) Rainy (c) Shine (d) Sunrise image type

## 3. FINE-TUNED EFFICIENTNETB3 MODEL

The EfficientNetB3 model demonstrated in Fig. 2 is the basis that is used to classify four weather conditions, namely, cloudy, rainy, shine, and sunrise. To bring it to this task, the architecture was made finer with introducing custom layers on top of the already trained base, which already has 11,184,179 parameters.

Layer (Type)	Output Shape	Param #
EfficientNetB3 (Functional)	(None, 1536)	10,783,535
Batch Normalization (BatchNormalization)	(None, 1536)	6,144
Dense	(None, 256)	393,472
Dropout (Dropout)	(None, 256)	0
Dense_1	(None, 4)	1,028
<b>Total Parameters</b>		<b>11,184,179</b>
<b>Trainable Parameters</b>		<b>11,093,804</b>
<b>Non-Trainable Parameters</b>		<b>90,375</b>

Fig. 2 Layer-wise depiction of the Proposed Model

## 4. PROPOSED METHODOLOGY

The process of weather condition classification with the help of EfficientNetB3 model is organized into four separate stages: Dataset Collection, Data Pre-processing, Model Development, and Model Evaluation.

Phase 1: Dataset Collection: At this step, an open-source platform with four types of weather such as clouds, rain, shine, and sunrise is gathered using such a system as Kaggle.

Phase 2: Data Pre-processing: The images obtained are downsized to the input dimensions of EfficientNetB3. Data augmentation where rotation, flipping, and brightness adjustments are used to enhance dataset diversity and data overfitting is avoided.

Phase 3: Model Development: This step is devoted to the development of the EfficientNetB3 model based on the transfer learning on ImageNet. This is done through fine-tuning of parameters to balance depth, width and resolution through compound scaling.

Phase 4: Model Evaluation: The last process is to test the performance of the model based on accuracy, precision, recall, and F1-score. To determine the effectiveness of classifications, confusion matrices are created to evaluate the effectiveness of classifying each category.

## 5. RESULTS

The adjusted EfficientNetB3 model, that had 11484179 parameters and additional dense layers, was highly accurate in the classification of four weather types. Dropping enhanced generalization, minimizing overfitting, and increasing reliability, and showed robust performance with architectural differences and fine-tuning.

### A. Classification Report Analysis

As the Fig. 3 classification report indicates, EfficientNetB3 with fine-tune strategy has high degree of performance in classifying four weather conditions namely Cloudy, Rain, Shine, and Sunrise with an overall accuracy of 97 percent.

Class	Precision	Recall	F1-Score	Support
Cloudy	1.00	0.96	0.98	23
Rain	1.00	1.00	1.00	14
Shine	0.95	0.91	0.93	23
Sunrise	0.94	1.00	0.97	30
Accuracy			0.97	90
Macro Avg	0.97	0.97	0.97	90
Weighted Avg	0.97	0.97	0.97	90

Fig. 3 Classification Report Analysis

### B. Training and Validation loss Analysis

The loss trends of training and validation during 25 epochs are shown in the graph in Fig. 4. First, the two curves decrease and this indicates effective learning of the training data. Nevertheless, beyond epoch 15 the loss in training keeps decreasing and validation loss levels off or increases, which is an indication of overfitting.

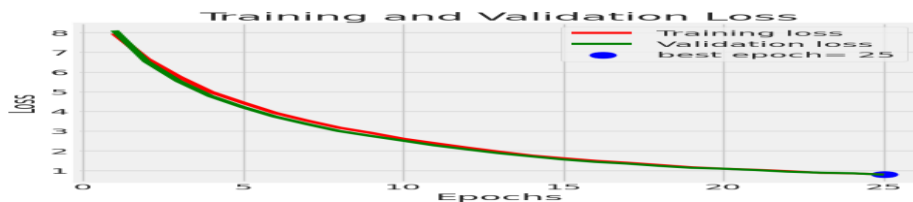


Fig. 4 Training and Validation loss Analysis

### C. Training and Validation Accuracy Analysis

The accuracy trend of the model across 25 epochs is shown in the graph in Fig. 5. At the beginning, training and validation accuracy increase and exhibit effective optimization.

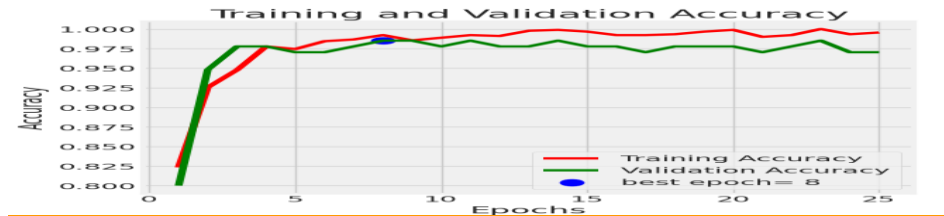


Fig. 5 Training and Validation Accuracy Analysis

#### D. Confusion Matrix Analysis

The confusion matrix (Fig. 6) gives a more precise analysis of the model performance in four weather types Cloudy, Rain, Shine and Sunrise. Diagonal items are correct classifications and off-diagonal items denote errors.

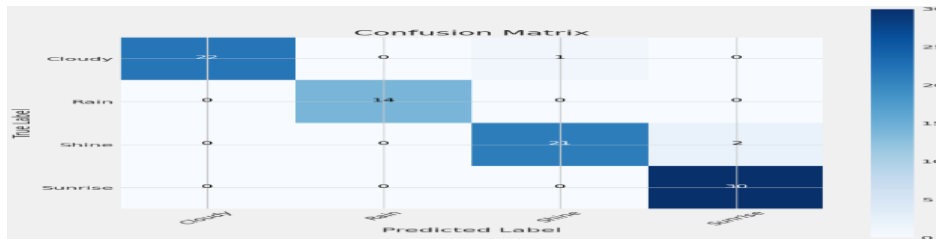


Fig. 6 Confusion Matrix Analysis

## 6. CONCLUSION

Proper and fast categorization of weather conditions is essential in disaster management, transport, and in agriculture. This paper has shown that the EfficientNetB3 model is useful in classifying four types of weather: cloudy, rainy, shine, and sunrise. With compound scaling used to scale depth, width and resolution, the refined model with 11,484,179 parameters had not only high computational efficiency but good classification accuracy. The model provided excellent results after conducting the test on a large dataset where the overall accuracy was 97%.

## REFERENCES

- [1] Roser, M. and Moosmann, F., 2008, June. Classification of weather situations on single color images. In 2008 IEEE intelligent vehicles symposium (pp. 798-803). IEEE.
- [2] Guerra, J.C.V., Khanam, Z., Ehsan, S., Stolkin, R. and McDonald-Maier, K., 2018, August. Weather Classification: A new multi-class dataset, data augmentation approach and comprehensive evaluations of Convolutional Neural Networks. In 2018 NASA/ESA Conference on Adaptive Hardware and Systems (AHS) (pp. 305-310). IEEE.
- [3] Piotrowicz, K. and Ciaranek, D., 2020. A selection of weather type classification systems and examples of their application. Theoretical and Applied Climatology, 140, pp.719-730.