Development of application for cloud type classification using machine learning techniques

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Abstract

Clouds regulate Earth's energy balance and aid weather prediction, but accurate classification requires expertise. To address this, we developed "Qmulo", a cloud classifier web app using CNN (Convolutional Neural Network). This AI system analyzes image features for classification. We sourced cloud datasets from Kaggle, manually sorted them into 8 types, trained the model, and developed an iOS app using XCode.

The results found that training the machine learning with different number of images used in different iterations results in different Train accuracy and Validation accuracy values, we have sorted levels of the application performance into 4 groups

- Low classification capability includes Cirrocumulus and Stratocumulus
- Mediocre classification capability includes Cumulus
- Good classification capability includes Altostratus, Cirrostratus and Cirrus
- Great classification capability includes Altocumulus and Cumulonimbus

Research Scope

Hypothesis

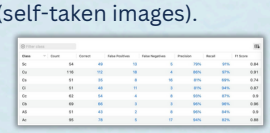
If the system receives a sufficient and diverse amount of cloud type data, it will be able to classify clouds accurately and correctly.

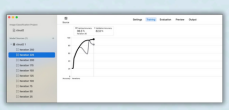
Objective

- To improve the application that identifies the types of clouds with machine learning technique.
- To test the quality of the machine that identifies the types of clouds that has been improved.

Methodology

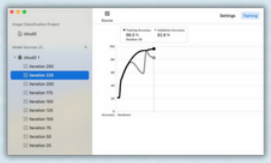
1. Collect and select cloud photos from the Kaggle website, a resource for training the machine.
2. Manually filtered 8,413 photos from 5 datasets to ensure accurate training data, resulting in 8 types:
3. Write commands to train machine learning on “Google Colaboratory” with different number of images at a time (25-250 images).
4. Select the training set with the best Train accuracy and Validation accuracy and build an application using Xcode.
5. Test the application performance with another set of prepared cloud images (self-taken images).
6. Conclusion

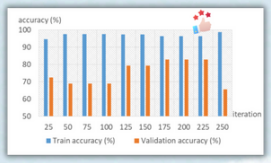




Results & Discusstion

Training the machine learning with different number of images used in different iterations results in different Train accuracy and Validation accuracy values as shown in the graph.



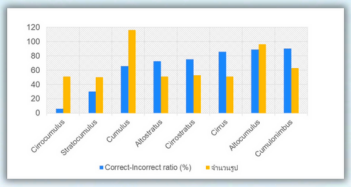


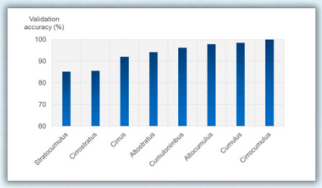
Performance testing of the “Qmulo” application found that:

- Cumulonimbus clouds had the highest correct-incorrect ratio of 90 percent,
- Altocumulus clouds at 88.57 percent
- Cirrus clouds at 85.70 percent.

The application's cloud type identification accuracy found that

- Cumulus clouds had the highest accuracy at 98.52 percent
- Altocumulus clouds at 97.85 percent
- Cumulonimbus clouds at 96.27 percent, respectively.





Conclusion

The results of the cloud classification performance test of the “Qmulo” application can be classified into 4 levels as follows

Cloud Type	correct-incorrect ratio	Validation accuracy	C.V.
Cirrocumulus	5.88	100.00	(1 รูป)
Stratocumulus	30.00	85.21	0.30
Cumulus	65.38	98.52	0.05
Altostratus	72.41	94.18	0.11
Cirrostratus	75.00	85.53	0.18
Cirrus	85.70	92.09	0.13
Altocumulus	88.57	97.85	0.09
Cumulonimbus	90.00	96.27	0.09

In conclusion, The results we got are not at the level that we want and only 2 of the cloud types can be sorted efficiently. Therefore, we will have to raise the cloud pictures for each cloud type to 100, so the machine learning could give a better result and increase community participation in monitoring environmental changes.

References

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