SATELLITE IMAGE CLASSIFICATION USING HOG AND DAISY FEATURE DESCRIPTORS

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Introduction

- Advancements in remote sensing techniques provide crucial information for a variety of applications, including landscape changes, land cover categorization, enhanced weather forecasting, and climate observation. These satellite devices can detect hazardous or dangerous conditions without endangering people or equipment.

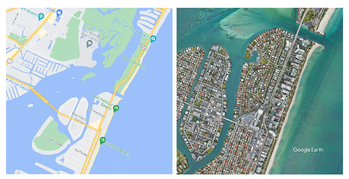


Fig. 1: Example of Satellite imagery of Bal Harbour (source: https://www.google.com/maps/@25.8937458,-80.1204445,15.5z/data=!5m2!1e4!1e2)

- With the recent breakthroughs that have made satellites both more powerful and cheaper to deploy, the volume of high-resolution satellite images collected has increased exponentially. Manual classification techniques of these high-resolution satellite images are too inaccurate and inefficient to handle the challenge. Hence, automation of satellite image classification has become a crucial part of the field of remote sensing.
- The main objective of the research paper is to create an efficient, and reliable autonomous classification models using the bag of features method on the UC Merced landuse dataset, and improve the accuracy and overall effectiveness of the algorithm proposed by [2] mainly for object recognition in satellite imagery.

Related Work

- Several experiments where proposed for satellite classification. When there is a large volume of input, neural networks produce good models [3]. The present research is being conducted with a comparatively limited data collection, as a result CNN are not the best approach for this analysis.
- Various supervised algorithms were tested using a variety of efficiency metrics in [4] and the Support Vector Machines was the best of the proposed modes.

Method	Year	Accuracy
BOVW+SCK	2010	77.71%
Dirichlet	2013	92.80%
VLAD	2014	94.30%
DCNN+SIFT BOVW	2018	95%
Inception-v3-CapsNet	2020	80%

Table 1: PROPOSED METHODS ON THE UC-MERCED DATASET.

RESEARCH METHODOLOGY

- We construct an object recognition method that includes extraction of features, encoding, pooling, and classification of images on the UC-MERCED dataset as shown in Figure 3
- For feature extraction we use DAISY descriptor which were proposed by [1]. We use a bag of features encoding using the Mini-Batch K-Means method and L2 pooling. we perform a 10-fold cross-validation experiment with a support vector machine (SVM) classifier and classify our results on a dataset of 21 scene categories

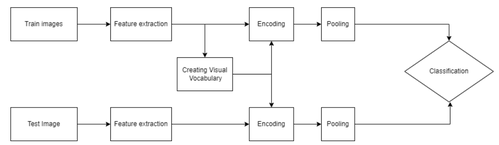
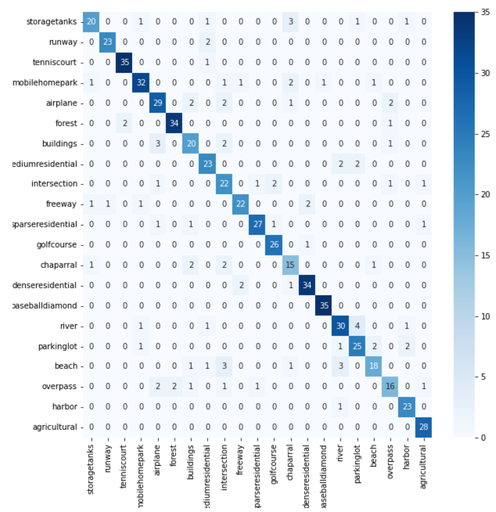


Fig. 2: Flow diagram of the proposed BOF model

Results

- Histogram of oriented gradients (HOG) classifier proved to an be unviable approach for our classification task.
- The hybrid model, which combines SVM with an RBF kernel, demonstrated to be among the most effective, with an accuracy of 81.42%, while the linear classifier came in second, with an accuracy of 76.19%.



Confusion matrix of the best model: Hybrid classifier with SVM+RBF kernel

- The Confusion matrix show the performance of a Hybrid model

Classifier	Accuracy
Hybrid Classifier	81.42%
KNN	68.02%
Linear Classifier	76.19%
HOG only	36.73%
DAISY only	73.40%

Table 2:Shows accuracy of the classifiers with the proposed SVM hybrid model out performing all models

Conclusion

- The experimental results in this research are comparable to those obtained by [2].
- While the UC Merced land-use dataset is one of the most popular for satellite image classification, it is limited to merely 21 classes, which is a pretty small number compared to the number of existing satellite classes.
- This makes developing models that generalize to a broad variety of classes challenging.
- In addition, a new dataset with a huge number of image samples will make it easier for models to adapt to complex networks.

Future Work

- For future approach a convolutional neural network may be employed and a dataset having a considerable number of classes can be utilized.
- This additional datasets might boost prediction performance as a number of distinct scene classes will be covered and data sensitive algorithms will increase performance owing to existence of more data

References

[1] Engin Tola, Vincent Lepetit, and Pascal Fua. “Daisy: An efficient dense descriptor applied to wide-baseline stereo”. In: *IEEE transactions on pattern analysis and machine intelligence* 32.5 (2009), pp. 815–830.

[2] Jobin Wilson and Muhammad Arif. “Scene recognition by combining local and global image descriptors”. In: *arXiv preprint arXiv:1702.06850* (2017).