

Clustering Faces of Comic Characters

An Experimental Investigation

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1. Research Questions

How effective is face clustering on comic characters?

- How effective are different feature extraction methods for comic face clustering?
- Can we improve the discriminative power of feature extraction methods by combining their feature vectors and autoencoding them?
- Can we outperform K-Means++ using Approximate Rank-Order Clustering and noisy sample detection?

2. Experimented Methods

- **Feature Extraction**
 - Histogram of Oriented Gradients (HOG)
 - Local Binary Patterns (LBP)
 - Oriented FAST and Rotated BRIEF (ORB)
 - Color Histograms
 - SimCLR
- **Autoencoding (Dimensionality Reduction)**
 - Neural Network Autoencoder
 - PCA
- **Clustering**
 - K-Means++
 - Approximate Rank-Order Clustering

3. Methodology

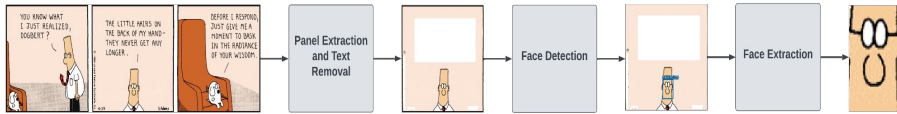


Figure 1: The face extraction pipeline used to compile our Dilbert Comics face image dataset.

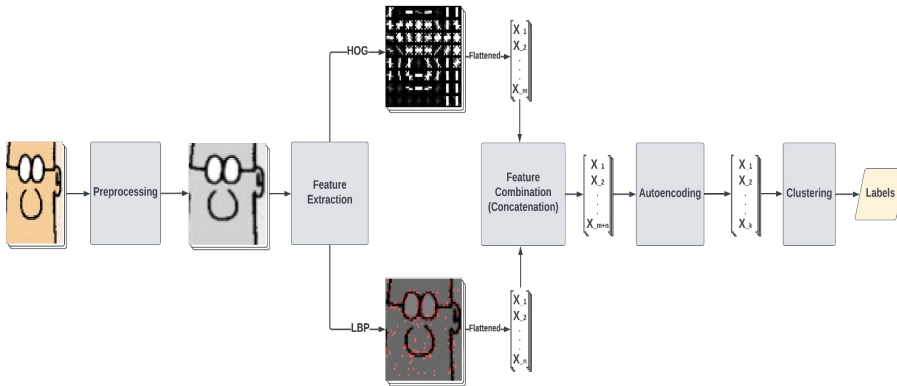
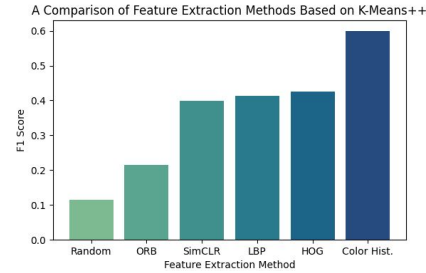


Figure 2: The face clustering pipeline used to compare the effectiveness of various feature extraction methods, clustering methods, and feature combination. HOG and LBP are example feature extraction methods that can be swapped with others.

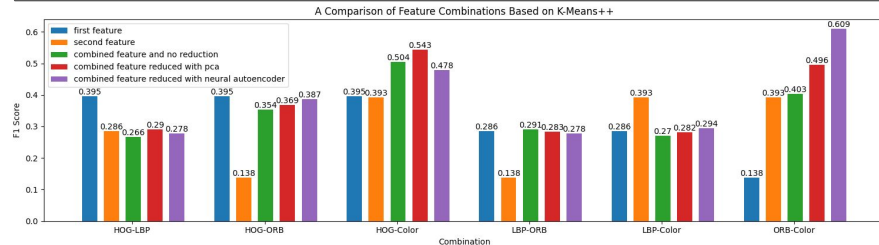
4. Comparison of Features



7. Conclusions

- Using color information is crucial for accurate comic face clustering.
- Combining feature extraction methods does not guarantee an increase in clustering accuracy. However, combining color with shape features does improve accuracy.
- Autoencoding the feature vectors generally enhances the clustering performance. However, the increase is marginal in most cases.
- Removal of noisy samples with hierarchical clustering can drastically increase the precision of clustering and result in purer clusters.

5. Effectiveness of Feature Combination



6. Comparison of Clustering Methods

- Approximate Rank-Order Clustering (AROC) is a hierarchical clustering algorithm.
- We extend it with a custom parameter called `min_samples`, which allows us to label data points as noisy if the cluster they belong to has fewer than `min_samples` data points.
- The results of AROC in Table 1 are obtained by setting `min_samples` to 100.

Feature	Clustering	# Img.	# Clustered Img.	# Test Img.	# Clusters	Precision	Recall	F1
Color Hist.	K-Means++	77,768	77,768	1,236	12	0.499	0.754	0.600
Color Hist.	AROC	77,768	20,988	317	35	0.886	0.653	0.752
ORB-Color	K-Means++	76,885	76,885	1,236	12	0.578	0.643	0.609
ORB-Color	AROC	76,885	22,441	411	100	0.730	0.438	0.547

Table 1: A comparison of AROC and K-Means++ clustering on the best-performing single and combined features.