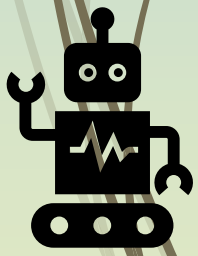
Content-Based Image Retrieval

CS360 : Machine Learning Lab



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Introduction

- **Content-based image retrieval (CBIR) is the application of computer vision to the "Image Retrieval problem", that is, the problem of searching for digital image in large databases.**

- **"Content-Based" means that the search will analyze the "actual-contents" of the image. The term 'content' in this context might refer colors, shapes, histogram based and texture or any other information that can be derived from the image itself.**

Problem Definition

Image search engines become indispensable tools for users who look for images from a large-scale image collection and World-Wide Web.

Its key technique is content-based image retrieval (CBIR) having the ability of searching images via automatically derived image features, such as color, texture or shape. The major difficulty of CBIR lies in the big gap between low-level image features and high-level image semantics.

Materials

Dataset Descriptions :

- **Wang's dataset of 1000 Coral Images.**
- **These images are grouped into 10 categories with each category containing 100 images.**

Table

Images	RGB Scaled
Size of Images	256*85 or 85*256
Associated Tasks	Classification, Clustering
Number of Images	1000

Related Researches

Research Paper	Year	Methodology	Accuracy	Precision/ recall
Content-Based Image Retrieval based on Hybrid Feature Extraction and Feature Selection Technique Pigeon Inspired based Optimization	2021	ANN, MLP, KNN	93.34, 81.72, 85.14	Precision: 91,52 ,39 Recall: 90 ,68 ,79
Content-based image retrieval using feature weighting and C-means clustering in a multi-label classification framework	2020	C-means clustering, KNN classification	57.74, 54.94	Precision: 75.05, 74.88 Recall: 62.41, 59.28
Content-based image retrieval using PSO and k-means clustering algorithm	2014	K-means clustering algorithm, PSO	85.5	Precision: 80.1 Recall: 85

Content-Based Image Retrieval based on Hybrid Feature Extraction and Feature Selection Technique Pigeon Inspired based Optimization :

Introduction:

CBIR consists of retrieving the most visually similar images to a given query image from a database of images. In this research study, Haralick Features are extracted, which is also known as Gray-Level Co-Occurrence Matrix (GLCM) along with Local Binary Pattern (LBP), and histogram of oriented gradients (HOG) features.

Conclusion:

In this research study, the final output is retrieved from the database using feature extraction from the input query images. The research study has two process namely training process and testing process. Based on the texture and color vector, the segmented images are converted into HSV images as well as gray-scale images. s. In the testing process, when the user gives a query images, the process will be same as training process and finally, to extract the relevant images, the training images are taken from the dataset and compared with the query images using ANN classifier. From the classification results, the most similar results are retrieved to the end-user. The experimental results shown that the proposed ANN achieved only 93.34% of overall classification accuracy without FS techniques, where the same technique achieved 97.34% of overall classification accuracy, while incorporating with proposed FS techniques. In future, an ensemble classifier is required to implement for effective image retrieval by using huge amount of query images.

Content-based image retrieval using feature weighting and C-means clustering in a multi-label classification framework:

Introduction:

In this paper, a novel learning algorithm based on feature weighting is proposed to improve the performance of image classification or retrieval systems in a multi-label framework. The goal is to exploit maximally the beneficial properties of each feature in the system.

Conclusion :

The proposed method was evaluated on the Corel1000 database of images. The database consists of 1000 images from 10 categories in which each category has 100 images. There are 256 color and 192 texture feature, 5 label and feature type “Numeric(real)”. we compare our results before and after the MLC-FWC algorithm within the multi-label classification framework. Second, we compare the MLCFWC method to methods in which use feature weighting (FW) or feature fusion (FF) algorithms to combine features in a single-label image retrieval framework. Average value of accuracy : color is 63.69, weighted color is 57.74, texture is 58.33, weighted texture is 54.94, color texture is 60.56, weighted color texture is 66.65 so the overall accuracy is 60.30.

Content-based image retrieval using PSO and k-means clustering algorithm:

Introduction:

In this paper, a novel learning algorithm based on feature weighting is proposed to improve the performance of image classification or retrieval systems in a multi-label framework. The goal is to exploit maximally the beneficial properties of each feature in the system.

Conclusion:

The WANG database is broadly used for CBIR field, which is why it was implemented in this study. The database holds 1,000 images divided into 10 classes and in each class are 100 images. In this study, color images are applied to extract the color and texture features and to use it for similarity matching because most images in our world are color images. In this model we get class-wise precision and recall. These are following(Precision/ Recall) :

Foods: 0.9/0.75	Mountain: 0.94/0.55	Horses: 0.72/0.88
Flowers: 0.85/0.92	Elephants: 0.82/0.8	Dinosaurs: 0.72/1
Buses: 0.7/0.83	Architecture: 0.95/0.7	Beach: 0.95/0.72
Africans: 0.98/0.89		

Methodology

Dataset features Extracting:

- **Using Grey-scaled histogram** :
  - 256 features
  - 1000 patterns
  - Csv file that contains histogram of Grey scaled images

- **Using RGB – scaled histogram**:
  - 256 features
  - 1000 patterns
  - Csv file that contain histogram of 3 different channels (red, green and blue) wise images

Methodology

Classification of Content Based Image Retrieval:

- Logistic Regression (one vs all/rest)
- Single Layer Perceptron (one architecture) i.e. SLP
- Sigmoid Neuron (one architecture)
- Multi-layer Perceptron (input layer, hidden layer, output layer) i.e. MLP

Result and Analysis

Logistic Regression :

- Overall Accuracy on training data : 41.15%
- Overall Accuracy on test data : 40.4%
- Overall Accuracy on Validation data : 33.025%
- Class-wise Accuracy :

1)0.15996	2) 0.48818	3) 0.4116	4) 0.25186	5) 0.35872
6) 0.18488	7) 0.39368	8) 0.79566	9) 0.416	10) 0.65338

- Precision : 52.44%
- Recall : 41.12%
- F1- score : 37.81%
- Weighted – Avg : [45.12% , 42.7% , 38.37%]

Result and Analysis

Single Layer Perceptron :

- Overall Accuracy on training data : 25.3%
- Overall Accuracy on test data : 25.3%
- Overall Accuracy on Validation data : 28.74%
- Class-wise Accuracy :

1) 0	2) 0.885822	3) 0.00833	4) 0.2852	5) 0.374526
6) 0.09275	7) 0.2747	8) 0	9) 0.52421	10) 0.30781

- Precision : 32.89%
- Recall : 25.73%
- F1- score : 21.02%
- Weighted – Avg : [33.16% , 25.3% , 20.85%]

Result and Analysis

Sigmoid Neuron :

- Overall Accuracy on training data : 18.8%
- Overall Accuracy on test data : 18.8%
- Overall Accuracy on validation data : 20.625%
- Class-wise Accuracy :

1) 0	2) 1	3) 0	4) 0	5) 0.5326
6) 0	7) 0.0994	8) 0	9) 0	10) 0.23556

- Precision : 12.61%
- Recall : 18.67%
- F1- score : 24.50%
- Weighted – Avg : [23.14% , 20.1% , 19.18%]

Result and Analysis

Multilayer Perceptron :

- Overall Accuracy on training data : 10%
- Overall Accuracy on test data : 10%
- Overall Accuracy on validation data : 9.375%
- Class-wise Accuracy :

1) 1	2) 0	3) 0	4) 0	5) 0
6) 0	7) 0	8) 0	9) 0	10) 0

- Precision : 1%
- Recall : 10%
- F1- score : 1.9%
- Weighted – Avg : [3.4% , 10% , 1.9%]

Result and Analysis

Que.1) Is there any Overfitting issue?
Ans: By observing all four graphs of overfitting, I can conclude that there is no overfitting issue.

Que.2)Is there any class imbalance?
Ans: No ,there is no class imbalance. Because after data analysis, I got that there was 10 class and 100 pattern belongs to all classes so no class imbalance.

Que.3) How many K-fold?
Ans: There are 5 fold for every algorithm.

Que.4) What's value get in hyper-parameter tuning using validation set?
Ans: Following are:
i)Epoch: 250 ii)Alpha: 1e-05 iii)Roh: 1e-07 iv) n_itr_no_change: 11

Que.5) What's the best overall accuracy ?
Ans: My Model hit best overall accuracy in Logistic Regression with 41.15% in training accuracy, 40.4% in Testing accuracy and 33.025% in validation accuracy.

References :

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