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Automated Image Classification System using Color and Texture Features

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Abstract: With the consolidation of the Internet as a medium for information interchange, several news agencies and educational organizations have allowed on-line access to their image and video collections in digital format. Therefore, a crucial task is to organize these large volumes of pictorial data, in order to extract relevant information. It is possible to address this problem by performing an automatic classification of images. This paper is an attempt to develop an automated system for image classifications for aquamarine learning system. The proposed system will have fast & robust retrieval algorithm for contour images.

Keywords: Knowledge base (KB), DB image, Feature Extraction, Co-occurrence matrix.

Introduction

Image classification is an active area in the field of machine learning, in which it uses algorithms that map sets of input, attributes or variables – a feature space - to set of labelled classes [1][2]. These algorithms are known as classifiers. There are two main stages in a classification system: training and testing stage. Training is the process of defining criteria by which features are recognized. In this process the classifier learns its own classification rules from a training set. In the training process, images are captured and stored in a database. Then there is the process of feature extraction. An image is represented by a set of descriptors that structure the feature vectors. These feature vectors are considered input variables and are introduced in a learning component. The outputs are labels associated with classes.

In the learning component you have the discriminative and the generative models. The first model maps input variables directly to output variables in order to perform classification. The generative field models the distribution of features and learning is based on the likelihood of the data. In the testing stage, the feature vectors of test image works as input. A classifier decides on the bases of learning model, with its own classification rules, as to which class that feature vector belongs. The most notable research in this field involves recognizing human faces—otherwise known as Eigen face systems [3].

Training the system

The developed system is trained with fish from eight different classes namely, Lancdet, Lamporey, Electriceel, Piranha, Bowfin, Trout, Angle Fish and Cardinal fish [4]. The extracted features of the fish are used after normalization to train the developed model [5]. During the training procedure of the knowledge base, the maximum acceptable Mean Squared Error (MSE) is empirically set at 1×10^{-5}. The training process is carried out till the maximum acceptable MSE is reached. From all the training images, color and texture features are extracted and stored in separate databases. The color features are given to color model along with expected output and its actual output is checked. If the actual output is not equal to expected output within the specified required MSE is not reached, then the training parameters are adjusted and the process is repeated until the knowledge base is trained properly. This procedure is repeated for all the input training images. Similarly, texture and combined features are given to texture and combined models respectively along with expected output and the knowledge base is trained similar to training of color model [6][7].

Training the system

Input: Image of fish samples.
Output: Eleven features of each image is computed
Begin:

Step1: Training set image is taken.
Step2: Construct co-occurrence matrix with angle of rotation
Degree 0^0, 45^0,90^0& 135^0.
Step3: Compute feature vectors.(Contrast, Energy, Local Homogeneity, Maximum Probability, Entropy, Cluster shade, and Cluster prominence)
Step4: Compute the average of each of the features along with the rules is stored in Knowledge base.
End

During classification this method compares with the average range features value of test sample with average values stored in the knowledge base. If the values are matched approximately. The test sample is classified as one of the trained samples, once the knowledge base is trained.

Testing the system

In this phase, the fish from untrained set of samples are used to test the knowledge base classifier for classification of fish. From the test image, color and texture features are extracted and stored in separate files. The color features are given to color model and its output is checked. Similarly, texture and combined features are given to texture and combined models respectively and their outputs are tested.

Testing the system
Input: Test sample of image + knowledge base.
Output: Classified fish image, the recognized fish image with percentage of accuracy.
Begin:
Step1: Input test sample image of fish.
Step2: Construct co-occurrence matrix.
Step3: Compute feature Vectors. (Contrast, Energy, Local homogeneity, Maximum probability, Entropy, Cluster shade, Cluster prominence)
Step4: Compute the average feature values of testing sample.
Step5: Compare the average range feature values of test sample with the values stored in the knowledge base.
Step6: If the values are matched approximately then the test sample is classified as one of the trained sample.
Step7: Comparing classified images to its query image we get recognize image with graph showing percentage of matching.
End

Feature Extraction

In order to recognize image, the image has to be segmented and the shape of the image has to be extracted [8]. The steps for feature computation are as given below:

Segmentation

Segmentation is the process of separating objects from the image back ground and it subdivides an image into its constitute parts or objects. The level to which this sub division is carried depends on the problem being solved that is and segmentation should stop when the edge of the fish image is able to detected i.e. the main interest is to isolate the fish image from its background.

a). Histogram Equalization: It has been applied to enhance the gray level near the edge.

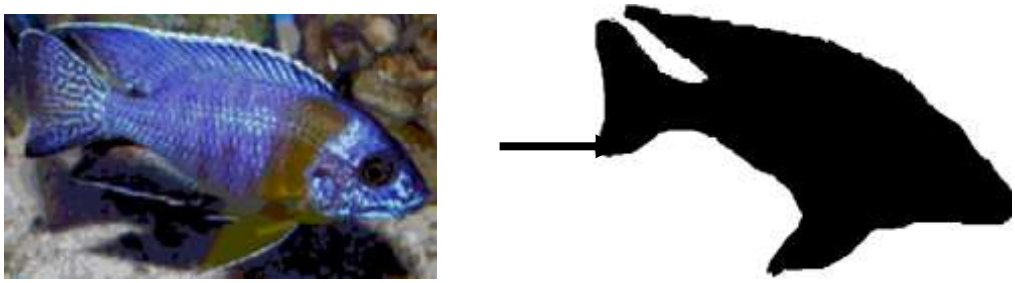

Fig 1: Illustration of fish image segmentation from the background

b). Thresholding: It is used to equalized image in order to obtain a binary image with gray level 1 representing the least image and gray level 0 representing the background.

Calculation of co-occurrence matrix $P_{\varphi,d}(x, y)$ from the image $f(x,y)$

Input: Input gray level image $f(x, y)$ (matrix of size $M*N$).
Output: Co-occurrence matrix $P_{\varphi,d}(x,y)$ for $d=1$ in the direction φ.
Begin
Step 1: Assign $P_{\varphi,d}(x,y)=0$ for all $x,y \in [0,L]$, where L is the maximum gray level.
Step 2: For all pixels (x_1, y_1) in the image, determine (x_2,y_2) which is at distance d in Direction φ and perform

$$P_{\varphi,d}[f(x_1,y_1), f(x_2,y_2)] = P_{\varphi,d}[f(x_1,y_1), f(x_2,y_2)]+1$$

End

Methodology for the proposed system

The knowledge base classifier is developed and the features are input to the knowledge base classifier. We consider database consists of 40 images of different color features. These databases are used to train the developed knowledge base classifier, which is explained in this paper. This paper also presents testing & validation of developed for classification of fish samples. We develop a knowledge base classifier for the recognition of fish image for aquamarine learning. Knowledge base is data base contain several fish image in which each fish have an 11 features computed in advance for training the database. Among classified image based on the global feature, the classified image is compared with the query image for recognition [9].
For classification of fish first given query image is processed in to different operation such as segmentation; here distinguish between fore ground and back ground [10]. And then go for an feature computation; which involves two method global based and local based, in global based method, based on external shape and outer wings of fish find an shape, color and textures; shape uses Histogram and Threshold to find exact shape, color finds an determinant of R,G,B values and texture finds an co-occurrence matrix of degree 0^0, 45^0,$90^0$and 135^0 in Local based method, based on its local features, there are various features extracted for a given image. The commonly used features are: Contrast(C), Energy (E), Local Homogeneity (LH), Maximum Probability (MP), and Entropy (EN), Cluster Shade (CS) and Cluster Prominence (CP), which can be used for training in the database. The obtained trained feature is compared with the test sample feature obtained and classified as one of the extracted features.

Conclusion

The result of this analysis generated a set of resultant images for a query image for content-based classification of images. Our contribution was to show that modern machine learning architectures can classify images using exactly the same 'input' as was available to human classifiers using color, shape and textural features. The present existing technology doesn't allow one to recognize the class of the fish from its image, the present paper gives a hand on technical tool to elaborate and to find out the class of a fish from its image. This is possible by our proposed approach. In this approach a database is created. This database consists of 240 images of fish of various classes. Once an image of a fish given to the query, the query read and compare with database.

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