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A Comparative Analysis & Survey of various Feature Extraction Techniques

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***Abstract* — Feature extraction is a process of extracting the common features from the image so that it can be used for a variety of application. There are various techniques implemented for extracting the image features. These features can be used for image matching or recognition techniques or learning in supervised algorithms. Here in this paper all techniques that are implemented for the extraction of features is discussed and a comparative analysis is shown in the paper so that by analyzing the various limitations of the algorithms a new and efficient technique can be implemented in future.**

***Index Terms*—Image Processing, Feature Extraction, DCD, CCV, CM, CSD, SIFT, SURF.**

I. INTRODUCTION

Digital Image processing is a technique of processing the image whether colored images, Gray Scale Image or Binary Images. The processing of images can be done using Feature extraction techniques, Classification techniques or clustering or recognition techniques.

1. 1 Image Feature Extractions using Color Space Models

Although there are various techniques implemented for the extracting the features of images, but image feature extraction using color based feature extraction is an important technique. There are various color space model discussed in the survey of [1]. Image can be classified as colored, gray or binary images. Color histogram [2] is also a technique which is based on the extraction of colors in image processing, in spite of this Color Coherence vector [3] and Color Moments based [4] and color correlogram [5] is also used for the extraction of features in image.

In all the above techniques mean, skewness and standard deviation is computed so that the features can be extracting easily.

$$\mu_i = \frac{1}{N}\sum_{j=1}^{N} f_{ij}$$

$$\sigma_i = \left(\frac{1}{N}\sum_{j=1}^{N}\left(f_{ij} - \mu_i\right)^2\right)^{\frac{1}{2}}$$

$$\gamma_i = \left(\frac{1}{N}\sum_{j=1}^{N}\left(f_{ij} - \mu_i\right)^3\right)^{\frac{1}{3}}$$

The above formulas are used to calculate mean and standard deviation and skewness respectively. Where fij is used for the color value and N is the total number of pixels in the image.

The various color methods that are described are as follows:

Color Method used for Extraction	**Usages of the methodology**
Histogram	Simple to Compute
CM	It is must compact and robust to use.
Correlogram	It provides spatial information
CSD	It provides spatial information
CCV	It provides spatial information
SCD	It is scalable and compact.
DCD	It is compact to use and robust as well as perceptual.

Table 1. Various Colors Space models for feature extraction

1.2 Image Feature Extraction using Textual Features

Some of the images can be processed using feature based, since texture is an important and common way of detecting the features of images so that they can be used for recognition and interpretation. Texture based Feature extraction can be classified as spatial and spectral texture based on their various advantages to use in the image processing.

Texture Method for Extraction	**Usages of methodology**
Spatial texture	It is easy to use and understand and can be extract information from any shape.
Spectral texture	It is robust and requires less computation.

Table 2. Various texture based feature extraction

The figure shown below is the example of feature points extracted from image

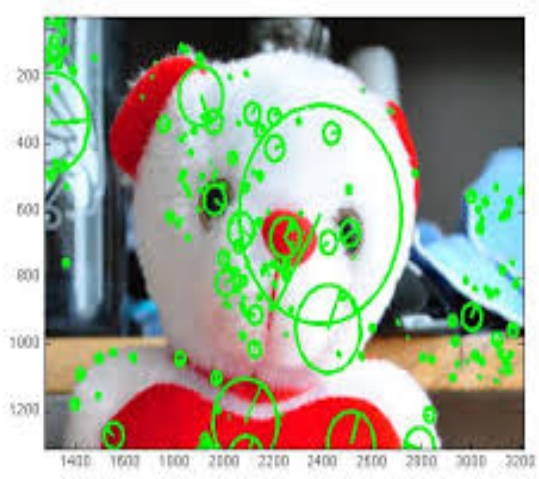

Figure 1. An Example set of Feature Extraction

II. Related Survey

Erkan Bostanci compares the various spatial statistics of the features of the image from various feature extraction techniques and compares their performances [6]. The technique used for the feature extractors and their performances and accuracy is compared here on large database.

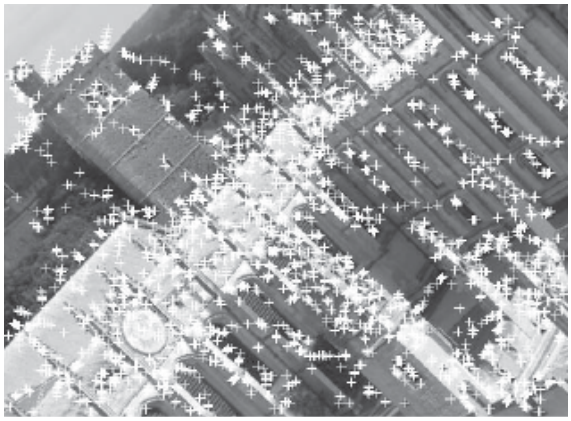

Figure 2. An output of the methodology [6].

Rosdiyana Samad, Hideyuki Sawada proposed a new and efficient technique of feature extraction using Gabor filters and convolution filters on the basis of edge base feature extractor [7]. Here in this paper the edge detection of six various human actions such as sadness, angry, happy, neutral, fear and surprise are detected using features extraction. The various facial features are detected using edge filtered by wavelet and then principle component analysis is used to reduce the feature components and their dimensions. The results generated here shows that the multiple detectors used using wavelet and convolution based provides much better results as compared to work in [8].

Tienwei Tsai, Yo-Ping Huang proposed a dominant feature extraction technique using DCT transformation [9]. Here in this technique the input image is first converted from RGB color space to YUV color space. The YUV color space image is divided into four blocks. The DCT transformation is applied on each block of the image that contains Y-component. The various textures are then integrated to produce a single vector that can be used for indexing and image retrieval.

Figure 3. An output of the methodology [7].

Aamer. S. S. Mohamed, Ying Weng, Jianmin Jiang and Stan Ipson implemented a new and efficient technique for the face retrieval using DCT based feature extraction [10]. The technique implemented here uses a six coefficient per block in the image block of size 8 * 8. The image from the database is retrieved by comparing the closest features with the image. The technique is useful to identify main objects in the image and hence its performance factor is more.

Marcin Grzegorzek, Michael Reinhold has given a wavelet based feature extraction from a set of statistical objects and provides recognition of objects in the image [11]. Here in this paper 3-D objects present in 2-D images can be recognized from a set of blocks of images of 8*8 and 4*4 and 2*2. The techniques successfully retrieved objects from images by using

Heterogeneous background.

Suganthy, M. and P. Ramamoorthy proposed a new way of feature extraction using principle component Analysis for the use of morphological detection of edges and for the fast iris recognition [12]. The technique is used for the removal of redundant and the data which is unwanted so that on the basis of which filtering of is done. Here after filtering wavelet packet transformation is applied and then matching is done using KNN.

Aleˇs Proch´azka and Jarom´ır Kukal have given work on the classification of EEG Signals using the concept of wavelet transform [13]. Here in the paper uses the concept of discrete wavelet transformation and then uses the concept of signal based segmentation and finally uses neural network for the clustering of the signals and classification. The paper also gives a wide comparison of various feature extraction techniques used for the EEG signals and their various components detection.

Minh HoaiNguyen and FernandodelaTorre proposed a new technique of feature selection and extraction using the concept of Support vector machines [14]. Support vector machine is a learning algorithm and is used for the clustering and classification of data. Here in this paper the optimization of the data is done for the selection of features stored in the image. The paper also contains a convex framework of energy-based to cooperate with the feature selection and then SVM learning used for the non-linear and linear kernels in SVM.

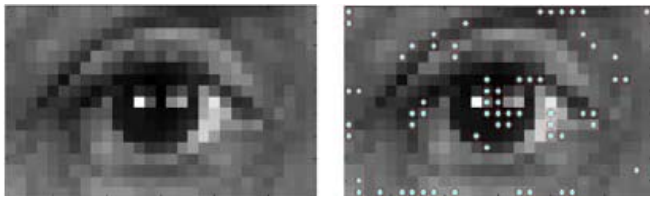

Figure 4. An output of the methodology [14].

Jean-Philippe Vert, Tomoko Matsui, Shin'ichi Satoh, Yuji Uchiyama use a high level extraction methodology using the concept of SVM with kernels used in walk based graphs [15]. The methodology implemented here uses the image to be first segmented into a finite set of segments and then using these segments a connected component graph is generated where each of the vertexes is a segment and contains a set of features associated with it. A positive kernel is then calculated by comparing walks between segmented graphs and then image can be classified using SVM.

Figure 5. An output of the methodology [15]

III. Comparision Of Varous Techniuqes

Detector	Mean	Median	Variance
IBR	15.7574	15.7932	1.5100
SURF	16.4002	16.3894	1.5089
HesAff	16.8054	16.8530	1.5080
HarAff	16.6006	16.7535	1.5079
EBR	16.9497	16.8731	1.5068
SIFT	15.9797	16.0828	1.5060
Harris	17.5607	17.6470	1.5055
SFOP	15.3130	15.3786	1.4952
HesLap	17.8867	17.9302	1.4922
SUSAN	16.6132	16.8873	1.4813
HarLap	16.5286	16.6276	1.4796
FAST	16.0879	16.2916	1.4783

Table 3. Evaluation Results of various detectors [1]

SIFT based feature extraction is a technique of finding the key features of any image.

1. Find the points, whose surrounding patches (with some scale) are distinctive
2. An approximation to the scale-normalized Laplacian of Gaussian

$$L(x, y, \sigma) = G(x, y, \sigma) * I(x, y)$$

$$G(x, y, \sigma) = \frac{1}{2\pi\sigma^2} e^{-(x^2+y^2)/2\sigma^2}$$

$$\begin{aligned} D(x, y, \sigma) &= (G(x, y, k\sigma) - G(x, y, \sigma)) * I(x, y) \\ &= L(x, y, k\sigma) - L(x, y, \sigma). \end{aligned}$$

Local Invariant Feature detector is used to find the local features of the image and then segment the global features from it so that the main features through which the various operations can be performed on the image can be detected.

IV. Conclusion

Here in this paper various feature extraction techniques and their various comparisons on different parameters are discussed. The paper also presents the various application areas where feature extraction techniques are used. Hence on the basis of their advantages and their performance a new and efficient technique can be implemented in future and hence their applications can be used in various fields such as recognition, classification and matching.

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