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Image Quality Metric Based Intensity Classification With Multi Support Vector Machine

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Abstract - *Data Mining is that the procedure method of discovering patterns in massive information sets. The goal of the mining method is the process of information extraction from a knowledge set. Image process is process of pictures victimization mathematical operations by victimization any variety of signal process that the input is a picture, like a photograph or video frame. In the proposed approach, video dataset is taken as input then from that video dataset, some sequence of images or frames should be extracted. With those sequence of images, first we will calculate the blind evaluation of metrics of image qualities like (contrast, blur, noise and entropy) for each frame. Then we will calculate non blind evaluation of metrics like (edge, histogram, thinning, and mse-psnr) of the image qualities for each frame. Finally, based on both evaluation, we will use the multi support vector machine for the classification of image quality metric series (IQMS). There are various methods and techniques are applied in previous work for the classification of image and it can be seen that the accuracy obtained in proposed work is 95%. Support Vector Machine is a very good method for image classification.*

***Key Words*: IQMS, Support vector machine, Data mining, image processing.**

1. INTRODUCTION

Data Mining is that the procedure method of discovering patterns in massive information sets. The goal of the mining method is the process of information extraction from a knowledge set and rework it into a plain structure for any use. Data mining is that the analysis step of the "knowledge discovery in databases" process. Data processing involves various common categories of tasks such as Anomaly detection, Association rule learning, Clustering, Classification, Regression and Summarization [1].

Image mining deals with the extraction of implicit information, image knowledge relationship, or different patterns not expressly keep within the image databases. It is associate degree knowledge domain endeavor that basically attracts upon experience in laptop vision, image process, image retrieval, data processing, machine learning and database.

Image process is process of pictures victimization mathematical operations by victimization any variety of signal process that the input is a picture, like a photograph or video frame. The output of image process is also either a picture or a group of characteristics associated with the image. The statistic categorization technique uses some easy visual illustration to research the statistic information, therefore it's terribly helpful to observe the modification mode and compress the series information. A statistic could be a sequence of information points, usually consisting of serial measurements remodeled an interval. Samples of statistic are ocean tides, counts of sunspots. Statistic are terribly oftentimes premeditated via line charts. Statistic are employed in statistics, signal process, pattern recognition, economics, mathematical finance, forecasting, intelligent transport and flight prediction, earthquake prediction, management engineering, astronomy, communications engineering, and mostly in any domain of subject field and engineering that involves temporal measurements. Statistical analysis comprises strategies for analyzing statistic information so as to extract important statistics and different characteristics of the information. Statistic prediction is that the use of a model to predict future values supported antecedently determined values. whereas multivariate analysis is commonly used in such the simplest way on take a look at theories that this worth's of 1 or additional freelance statistic have an effect on this value of over again series, this kind of research of your time series isn't known as "time series analysis" [2].

Support Vector Machines are unit supervised Learning models that analyze knowledge with associated learning algorithms and acknowledge patterns, used for classification.

Associate degree SVM model may be an illustration of the examples as points in area, mapped so the samples of the separate classes area unit divided by a transparent gap that's as wide as doable. Once knowledge isn't tagged, a supervised learning isn't doable, associate degree needs unattended learning that may realize natural agglomeration of the info to teams, and map new knowledge to those shaped teams. The agglomeration formula that provides associate degree improvement to the support vector machines is termed support vector agglomeration [8].

Multiclass Support Vector Machine aims to allocate labels to instances by exploitation support vector machines, wherever the labels are drawn from a finite set of many parts. Crammer and Singer projected a multiclass SVM methodology that casts the multiclass classification drawback into one improvement drawback, instead of moldering it into multiple binary classification. According to Vapnik's formulation, in one-against-all support vector machines, AN n-class drawback is reborn into n two-class issues and for the i^{th} two-class drawback, category i is separated from the remaining categories. But by this formulation unidentifiable regions exist if we have a tendency to use the separate call functions. Especially for one-against-all support vector machines, if we have a tendency to use continuous decision functions rather than separate call functions, unidentifiable regions are resolved [12].

2. METHODOLOGY

Our proposed calculation method is shown in Fig. 1. In the above approach, video dataset is taken as input then from that video dataset, some sequence of images or frames should be taken. After taking sequence of images, first we will calculate the blind evaluation of metrics of image qualities like (contrast, blur, noise and entropy) for each frame. Then we will calculate non blind evaluation of metrics like (edge, histogram, thinning, and mse-psnr) of the image qualities for each frame. Finally, based on both evaluation, we will use the multi support vector machine to find out the intensity, accuracy and class of IQMS.

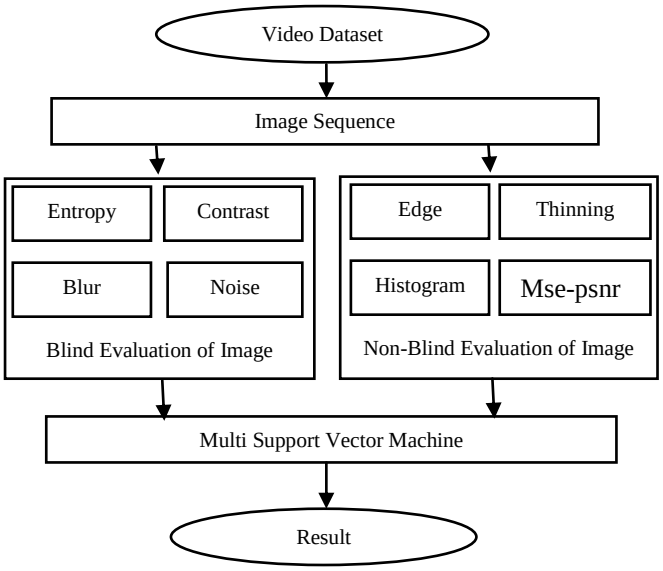

Fig-1: Proposed Calculation Flow Chart

2.1 Blind Evaluation of Image

In this paper we calculate the blind analysis metrics below to build our IQMS series:

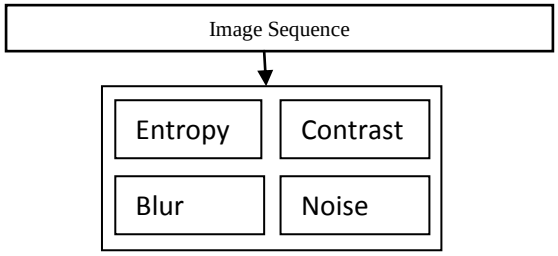

Fig-2: Blind Evaluation of Image

The blind evaluation of image includes the evaluation of some features like entropy level, contrast level, blur level, Noise level. Different to other image quality analysis metric, the calculation result of the blind evaluation metric ought to be freelance to the content of the image. Unfortunately, it is hard to design such a measure to describe the modification of the image quality objectively. So the process strategies of normalization and division square measure still essentially for outdoor application most of time. Image entropy is a quantity that is employed to explain the `business' of a picture, i.e. the amount of data that should be coded for by a compression formula. Low entropy images, such as those containing plenty of black sky, have very little distinction and enormous runs of pixels with a similar or similar DN values. An image that's absolutely flat can have associate entropy of zero. Consequently, they can be compressed to a comparatively little size.

On the other hand, high entropy pictures such as a picture of heavily cratered areas on the moon have a good deal of distinction from one element to consecutive and consequently can't be compressed the maximum amount as low entropy images. Blur is introduced in images and video through various processes such as acquisition, transmission and compression. There are varieties of blur exists for example, due to relative motion occur between the camera and the scene. Image noise is random color info in pictures, and is usually a side of electronic noise. It can be created by the sensing element and electronic equipment of a scanner or photographic camera. Image noise can additionally originate in film grain and within the inevitable shot noise of a perfect gauge boson detector.

Contrast is the distinction in luminosity or color that creates associate in nursing object distinguishable. In visual perception of the world, contrast is determined by the distinction within the color and brightness of the item and alternative objects at intervals a similar field of read. For calculating entropy of an image, see (1), for contrast, see (2), for blur, see (3)

$$H = -\sum_{k=0}^{M-1} P_k log_2(P_k) \quad (1)$$

$$H_c = \sum_{k=1}^{N} (J_{max}^k - J_{min}^k)/(J_{max}^k + J_{min}^k)/N \quad (2)$$

$$G(x) = \frac{1}{\sqrt{2\pi 6^2}} e^{-\frac{x^2}{26^2}} \quad (3)$$

In the above expression, P_i is the probability that the difference between two adjacent pixels is equal to i, and Log_2 is the base 2 logarithm. Where J_{max}^k and J_{min}^k are the maximum and minimum grey value of the k^{th} block. *N* is the number of the block. Where x is the distance from the origin within the horizontal axis, y is the distance from the origin within the vertical axis, and 6 is that the variance of the statistical distribution.

2.2 Non Blind Evaluation of Image

Edge detection is that the name for a collection of mathematical ways that aim at distinctive points in a very digital image at that the image brightness changes sharply or, additional formally, has discontinuities. A number of researchers have used a mathematician ironed step edge (an error function) because the simplest extension of the best step edge model for modeling the results of edge blur in sensible applications.

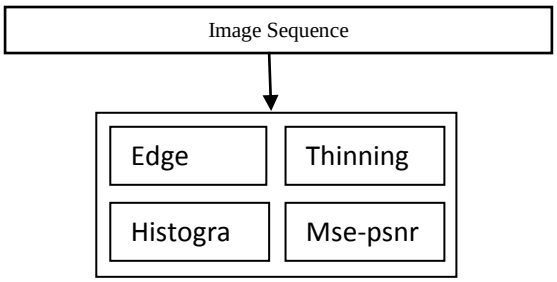

Fig-3: Blind Evaluation of Image

Thus, a 1-D picture g that has precisely one edge placed at $x = 0$ could also be modelled as:

$$g(x) = \frac{I_r - I_l}{2}\left(\text{erf}\left(\frac{x}{\sqrt{26}}\right) + 1\right) + I_l \quad (4)$$

The scale parameter is called the blur scale of the edge, the intensity of left edge is I_l and intensity of right edge is I_r. Following figure shows the edge detection applied in an image. Thinning could be a morphological operation that's accustomed take away designated foreground pixels. The dilution operation is expounded to the hit-and-miss remodel and may be expressed quite merely in terms of it. The dilution of a picture I by a structuring part J is:

$$thin(M,N) = M - hit\ and\ miss(M,N) \quad (5)$$

An image Histogram may be a variety of bar graph that acts as a graphical illustration of the tonal distribution during a digital image. It plots the quantity of pixels for every tonal worth. By viewing the bar graph for a selected image a viewer are able to choose the complete tonal distribution at a look. Histograms square measure typically confused with bar charts. A bar chart is employed for continuous information, wherever the bins represent ranges of knowledge, whereas a chart could be a plot of categorical variables.

The PSNR block computes the height signal-to-noise, in decibels, between 2 pictures. This quantitative relation is usually used as a high quality measuring between the first and a compressed image. The upper the PSNR, the higher the standard of the compressed, or reconstructed image. The Mean sq. Error (MSE) and therefore the Peak Signal to Noise quantitative relation (PSNR) area unit the 2 error metrics accustomed compare compression quality. The MSE

represents the accumulative square error between the compressed and therefore the original image, whereas PSNR represents a live of the height error. The lower the worth of MSE, the lower the error. To compute the PSNR, the block 1st calculates the mean-squared error victimization the subsequent equation:

$$MSE = \sum_{M,N}[I_1(m,n) - I_2(m,n)]^2 \quad (6)$$

In the above equation, M and N area unit the quantity of rows and columns within the input pictures, severally. Then the block computes the PSNR victimization the subsequent equation:

$$PSNR = 10\ log_{10}\left(\frac{R^2}{MSE}\right) \quad (7)$$

In the previous equation, R is that the most fluctuation within the input image knowledge.

2.3 Classification of Image with Multi SVM

Consider associate degree n-class downside. For a one-against-all support vector machine, we verify n direct call functions that separate one category from the remaining categories. Let the i^{th} call perform, with the most margin that separates category i from the remaining categories, be

$$D_i(x) = w_i^T f(x) + c_i \quad (8)$$

Where w_i^T is the *l*-dimensional vector, $f(x)$ is the mapping function that maps **x** into the *l*-dimensional feature space, and c_i is the bias term used in (Shigeo Abe 2005).

The hyper plane $D_i(x) = 0$ forms the optimum separating hyper plane, and if the classification downside is dissociable, the coaching knowledge happiness to category i satisfy $D_i(x) \geq 1$ and people happiness to the remaining categories satisfy $D_i(x) \leq -1$. Especially, support vectors satisfy y_i $D_i(x) = 1$. If the matter is indivisible, infinite support vectors satisfy y_i $D_i(x) = 1$ and finite support vectors satisfy y_i $D_i(x) \leq 1$. The remaining coaching knowledge satisfy $y_i D_i(x) \geq 1$. In classification, if for the input vector x

$$D_i(x) > 0 \quad (9)$$

is satisfied for one i, x is classed into class i. As a result of solely the sign of the decision perform is employed, the choice is separate. If (4.5) is satisfied for plural is or if there's no i that satisfies (4.5), x is unclassifiable. Think about the three-class downside with two-dimensional input as shown in below Fig:

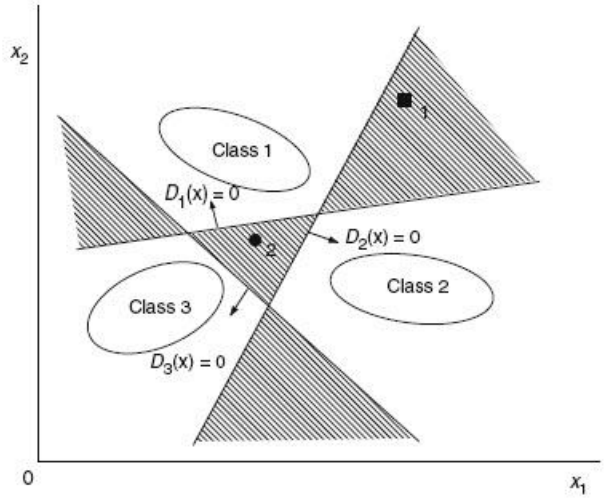

Fig-4: Unclassifiable regions by the one-against-all support vector machine

Wherever the arrows show the positive sides of the hyper planes. For data point 1,x_1, the three call functions are

$$D_1(x_1) > 0, \quad D_2(x_1) > 0, \quad D_3(x_1) < 0. \quad (10)$$

Because x_1 belongs to each categories one and a couple of, x_1 is unidentifiable. Likewise, for Datum 2,x_2, the three call functions are

$$D_1(x_2) < 0, \quad D_2(x_2) < 0, \quad D_3(x_2) < 0. \quad (11)$$

Thus x_2 is not classifiable. To avoid this, rather than separate call functions, continuous call functions are planned for classification. Namely, data point x is assessed into the class

$$\arg \max_{i=1,..,n} D_i(x). \quad (12)$$

Then data point 1 is assessed into category one as a result of $D_1(x_1)$ is that the maximum among the three. Likewise, data point 2 is classified into category 1.

3. RESULT

In this section, we throw some lights on experimental results which were conducted during the blind evaluation, non-blind evaluation and classification of image using multi support vector machine. For experimental dataset, see table 1 and for experimental result, see table 2

Table-1: Experimental Dataset

Dataset	Size	Type
1	204 frames	Video
2	3030 frames	Video
3	700 frames	Video

Table-2: Experimental Result

Technique	Dataset 1	Dataset 2	Dataset 3
Accuracy	95%	93%	92%
Precision	90%	88%	86%
Recall	100%	98%	96%
Specificity	90.9%	89%	87%

There are various methods and techniques are applied in previous work for the classification of image and it can be seen from the table 2 that the accuracy of proposed method support vector machine is 95%.

4. CONCLUSION AND FUTURE WORK

The Multi Support Vector Machine are applied for the classification of image. There are two type of evaluation should perform i.e. blind evaluation and non-blind evaluation of image. Blind evaluation of image technique includes contrast, blur, noise and entropy. Non-blind evaluation technique includes edge-detection, histogram, thinning and mse-psnr. Blind evaluation is used wherever comparison takes place without any influences or expectations. Experimental result shows that 95% accuracy is obtained by using support vector machine for the classification of image. By using SVM we get best output in image classification.

In future work, real time data can be used for navigation and tracking. We can also use another algorithm for the classification of image quality matric series. Shot detection technique can be used, which gives a video containing n shots with the beginning and end of each shots.

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