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No-Reference Quality Assessment and Feature Selection Using Bag-of-Words Model

Hrudya V N[1], Priya S [2]

M.Tech Student, Department of Computer Engineering, Model Engineering College, Thrikkakara, Cochin[1]

Professor, Department of Computer Engineering, Model Engineering College, Thrikkakara, Cochin[2]

Abstract: Multiple distortion assessment is a big challenge in image quality assessment (IQA). Here developing a no reference IQA model for multiply-distorted images. The NSS features, which are sensitive to each distortion, make a difference in quality. Multiple distortions are impaired by varying degree of distortions like blur, uneven illumination, noise and jpeg. The basis of model is to create different IQA metrics that are sensitive to blur, jpeg, noise and uneven illumination. The output of these metrics is combined to predict quality score. Subjective score is expensive and time consuming; due to that reason objective assessment should be taken for assessment of images. Applications in liveness detection and can be used for direct image recapture or correction.

Keywords: No-Reference Quality Assessment, Multiple Distortion, Image Quality Metrics, NSS features.

I. INTRODUCTION

No Reference image quality assessment (IQA) is important in many image processing and analysis applications for its ability to predict image quality without having a no-reference image. Numerous no reference IQA algorithms for special cases or specific distortion types have been proposed, among which the general purpose no reference IQA, which predict the visual quality of images without points to reference images or not have prior information of the distortion types, are the most challenging. Researchers have developed many state of the art algorithms for general purpose no reference IQA. An important problem still exists in IQA research. The distorted images in the available IQA datasets such as LIVEII, CSIQ, MICT and TID super from a single distortion type. Most of the existing IQA algorithms are tested on images with a single type of distortion. However, the images get to users by through several steps including acquisition, compression, transmission and reception. In this pipeline, they may super multiple distortions.

The Laboratory for Image and Video Engineering (LIVE) recently built a multiply distorted image quality dataset LIVEMD, for IQA research. This new multiple dataset consists of two parts are blur followed by noise. Experiments indicate some of the IQA algorithms show worst performance on this dataset compared to the performance on single distortion datasets. Here pointed out those multiply distorted images is one of the main problems for IQA because most IQA algorithm must not consider effects of these distortions on the image, but take effects of these distortions on each other. Feature explanation for image quality assessment is important. In IQA methods, all the assessment metrics are designed based on quality related features. The more importance to the feature which changes in image quality, the more effective the assessment metric will be. In this section a no reference IQA method for multiply-distorted images is proposed based on spatial and gradient domain using selected features.

II. RELATED WORK

II.1 Distortions

It means alternation of shape or something like objects, image etc.With the explosion of camera usage, visual traffic over networks and increasing efforts to improve bandwidth usage, it is important to be able to monitor the quality of visual content that may be corrupted by multiple distortions. There is an increasing demand to develop quality assessment algorithms which can check this vast amount of data and ensure its perceptually optimized delivery.

A) Single Distortion:

- Blur: Gaussian kernels (standard deviation G) were used for blurring with a square kernel window of side 3 (rounded off) using the Matlab fspecial and imfilter commands. Each of the R, G and B planes of the image was blurred using the same kernel.
- JPEG: The Mat lab command was used for JPEG compressed images by varying the Q parameter (whose range is from 0 to 100) which parameterizes the DCT quantization matrix.

- Noise: Noise generated from a standard normal pdf of 2 variance N was added to each of the three planes R, G and B using the imnoise MATLAB function.

B)Multiple Distortions-

- Blur followed by JPEG: Each of the four blurred images was compressed using the JPEG encoder. Hence 16 images I j k kth reference image R , 0 i, j 3 where i denotes the degree of blur and j the degree of JPEG compression.
- Distortion Blur followed by Noise: Noise at each of the four levels was added to each of the four images generated by k, 2 the blurring stage. Therefore, 16 images I-j was generated from R K where i denote the degree of blur and j the degree of noise.

C) Photographic Distortion

- Optical Distortion: - In photography, distortion means an optical distortions which deforms and bends straight lines, which is why such distortion is also commonly referred to as curvilinear.
- Barrel Distortion: When straight lines are bending in a shape of a barrel, this type of distortion is called barrel distortion commonly seen on wide. These are different types of distortions used for image quality assessment. Dinesh Jayaraman [2] gives the description of different distortions. After section III describes the assessment of these distorted images.

III.FEATURE SELECTION AND QUALITY ASSESSMENT

Image quality aims at evaluate quality of image. And it indeed is difficult to compare with reference image directly. Through feature selection, get good description of image, and then through the comparison of features, we get the final evaluation. The aim of feature selection is to select subset of input variables as features. The main contributions are:

- It is necessary to and all possible feature subset.
- Every feature is meaningful for some of the discrimination.
- Variation with inter class and intra class should be high.

Here image quality assessment is used to encode the selected features. Digital images are usually affected by a wide variety of distortions during acquisition and processing, which generally results in loss of visual quality. Image quality assessment (IQA) is useful in many applications such as image acquisition, watermarking, compression, transmission, restoration, enhancement, and reproduction. The aim of IQA is to calculate the amount of quality degradation and is thus used to compare the performance of processing systems and optimize the selected parameters. Mainly quality assessment and feature selection is done using two domains

- Gradient Domain
- Spatial Domain
- Spatial Domain:

Techniques are based on direct manipulation of pixel images. It uses statistics of images for quality assessment. This model utilizes statistical features like mean, variance, and mean square for selection. It correlates these features with human perception. Use support vector machine and other classifiers to classify features and predict score. Here assessment Performance using spatial domain is independent of database. It can be implemented in real time applications.

A) Image quality assessment and feature selection using gradient domain

Gradient is a directional variation in the intensity or color in an image. Image gradients are used to extract information from images. Structural feature is extracted as the gradient represents in histogram of local binary pattern (LBP) calculated on the gradient map (GWH-GLBP). This is effective to describe the complex degradation pattern introduced by multiple distortions. This model uses image features and subjective score to predict quality. No-reference image quality estimator BRISQUE is used to predict score.

Here different methods are used in gradient domain are:

- Laplacian Pyramid

The method is focused on measuring the distortion of compressed video without reference. There are main steps measuring distortion and predicting video quality. Each frame of a N-sub band Laplacian pyramid, and then their intra sub band and intersub band statistical features are discarded. Three intra sub band features and inter sub band features are inputs of the quality model.

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➢ NSS Statistics

No-reference quality assessment of distorted images based on the natural scene statistics (NSS). The quality of a distorted image is then computed by the degree of deviation from the NSS models. Support vector regression (SVR) is employed to predict human mean opinion score (MOS) from multiple NSS features as the input.

B) Image quality assessment and feature selection using spatial domain

Here different methods are used in spatial domain are

➢ Multi scale Geometric Analysis

Wavelet domain natural image statistic metric (WNISM), which achieves best performance for image visual perception quality evaluation. WNISM has been recognized as the standard method for RR IQA, it does not take wavelet coefficients in different sub bands .Moreover, wavelet transforms cannot extract the geometric information, e.g., lines and curves, and wavelet coefficients are dense for smooth image edge contours. It should provide good consistency. This framework can be used in video quality assessment

➢ Morphological multi scale approach

Using non-linear morphological filters are used in multi-scale image decomposition; geometric information edges are maintained between different resolution levels. Edge distortion between the multi-scale representation sub bands of the reference image. Multi-scale image quality assessment (IQA) can be described as three-stage process. In the first stage, both the reference and the distorted images are divided into a lower resolution images set using multi-resolution decomposition. In the second stage, image quality/distortion is evaluated for all sub bands. In the third stage, a pooling is use to convert each level into a quality score, and these scores are combined into the multi-scale image quality measure.

➢ Bag Of Word Model

Represent a data item (document, texture, image) as a histogram over features. So it is an image representation method and used in image classification. Mainly use a Support Vector Machine (SVM) as classifier. Apply the trained classifier to the test image. Use to encode selected NSS (Natural Scene Statistics) features separately. Use linear combination to map image features to quality score. Requirements:-

- Accuracy of quality prediction.
- User friendly.
- Fast
- Low cost

IV. BAG OF WORDS MODEL

Two methods used in this framework are:

A. Coding:

Coding means that local features are encoded by a vocabulary and using encoded feature on the vocabulary is generated. The common issue describes the distribution of local features, while sparse coding methods better reconstruct the features.

B. Pooling:

Pooling transforms all local features on a vocabulary into image representation, which is fed into a classifier. Average pooling and maximum pooling are widely used. Recently, weighted average pooling and local pooling have shown better results. Typical steps of Bag of Words Model include: Fengying Xie proposed [1],

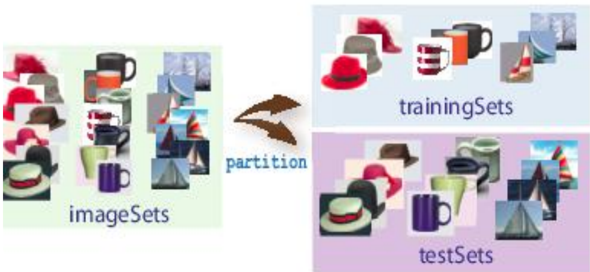

Figure 4.1: Flow chart of bag of world model.

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Step1: Set up Image Category set.
Step2: Create Bag of Features.
Step3: Train the image classifier with Bag of Visual Words.
Step4: Image Quality Prediction.

A. Image Category Set

- Organize and partition the images into training and test subsets. Use the image Data store function to store images to use for training an image classifier.
- Organizing images into categories makes handling large sets of images much easier. You can use the split Each Label function to split the images into training and test data.

- Step1: Create bag of words as features.
- Step2: Use SIFT feature descriptor for extracting the features from representative image category.
- Step3: The K-means clustering is used to group in to mutually exclusive clusters.
- Step4: Resulting cluster form a features or visual words.

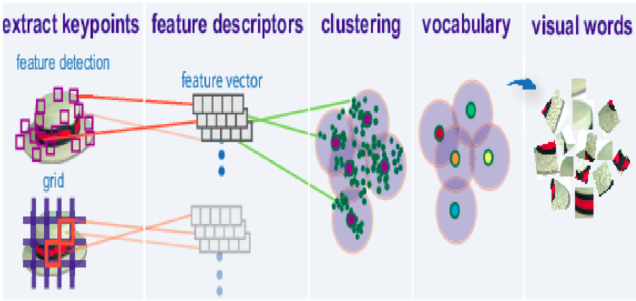

Fig:4.2 Feature Extraction using Bag of Words Model

- Step1: Use the bag of features use to encode each image from the training set.
- Step2: Use Support Vector Machine as image classifier to detect features in clusters and construct a feature histogram.
- Step3: Resulting histogram represents as a feature vector

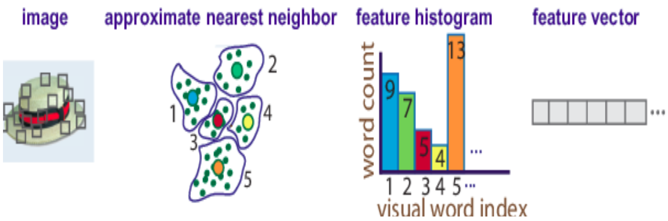

Fig 4.3: Flow chart of Classification of Bag of Words

V. IMAGE QUALITY PREDICTION

Quality assessment plays a crucial role in image analysis. Assessment method could be either subjective or objective performance.

➢ Performance:

Only widely used image quality approaches which have been showing good performance for different applications have been considered.

➢ Complementarity

In order to generate a system in terms of attacks detected and biometric modalities supported, we have given priority to IQMs based on complementary properties of the image.

➢ Complexity

In order to get the easiness of the method, low complexity features have been preferred over those which require a high computational load speed. This is, in general, closely related to the previous criterion (complexity)

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➢ Speed

This is, in general, closely related to the previous criterion (complexity). To assure a user-friendly application, users should not be kept waiting for a replay from the recognition system. For this reason, big importance has been given to the feature extraction time, which has a very big impact in the overall speed of the fake detection algorithm.

A) No-Reference IQ Measures

Unlike the No reference IQA methods does not require o a reference image to determine the quality of an image. Presently, NR-IQA methods generally estimate the quality of the test image according to some pre-trained statistical models.

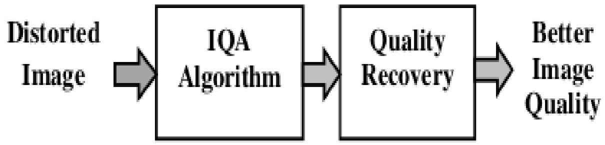

Fig 6.1 Flow chart of No-Reference Quality Assessment

➢ Distortion-specific approaches:-

These techniques required knowledge about the type of distortion caused the image. The final quality score is computed on original images and on images affected by this distortion. The JPEG Quality Index (JQI), which evaluates the quality in images affected byblock artifacts found in many compression.

Algorithm for JPEQ Quality Index
1: Compute JPEG Quality Index
2: Take input as distorted image p and q
3: Form a feature vector F1 and F2
4: F1(i,j):Feature vector blur distorted image.
5: F2(i,j):Feature vector of illuminated image.

$$J(P,Q) = \sum_{I=0}^{N} \sum_{J=0}^{N} f1 - \sum_{I=0}^{N} \sum_{J=0}^{N} f2$$

➢ Training-based approaches:-

Then, the quality score is computed based on an amount of features extracted from the test image and related to the general model. However, these metrics usually provide a general quality score not related to a specific distortion. This is the case of the Blind Image Quality Index (BIQI), which is part of the feature set used in the proposed work. The BIQI follows a two steps in which the individual measures of different distortion features are combined to generate quality score. It is calculated as

1: Compute BILIND INDEX METRIC gives quality score. 2: I(P,Q): Image intensity of distorted image P and undistorted image Q
3: S(P,Q): structural similarity of distorted image P and undistorted image Q.

➢ $B(P,Q) = \sum_{I=0}^{N} s(p,q)I(p,q)$

➢ Nss Features

These blind IQA techniques use a knowledge taken from natural scene distortion-free images.The aim is that undistorted images of the real world present certain regular properties which fall within in areas of all possible images. If quantified appropriately, deviations from the regularity of natural statistics can help to evaluate the perceptual quality of an image.

VI. CONCLUSION

Multiple distortions have complex influences on image quality and are a big challenge for IQA. A no reference IQA method, BoWSF for multiply-distorted images, is proposed. The features sensitive to each of the multiple distortions are selected from NSS features. An improved BoW model is then used to encode the selected image features. The encoding process is conducted separately for each type of multiple distortions in the images and the representation of the multiply-distorted image is then formed.

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