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Prediction of Video Defect Rate Analysis Tool using Object Quality Metrics

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Abstract: Video Analysis ensures quality of the video. The quality is directly correlated with video components. The video quality analysis has been performed with the help of quality features. Video Quality Assessment (VQA) algorithms are succeeding in assessing quality as a function of content which expects developments in that direction. The Feature based approaches are faster than the pixel based approaches. The work extracts edges from test video using canny edge detection algorithm for finding falsy edges and the edge difference. The work also focused on software defect density measure on video quality analysis to find defect density in the test video. The proposed Video Defect Rate Analysis Tool (VDRAT) estimates the defects analyzed by the comparison of original and distorted video frames. The frames are taken as inputs and detects original and reference frame to predict quality of the entire video and validation has been done by objective testing method.

Keywords: Video Analysis, Quality, video defect density, video defect rate, spatial Analysis, Edge detection

1. Introduction

Video is sequence of individual images or frames, several frames per second creates an illustration of motion. Human eye cannot identify individual frames in the sequence of continuous frames [1]. But human eye can identify faulty when occur frequently. To make subjective testing more effectively, it needs of specialized software or tool, laboratory environments, skills and numerous human test subjects. These kinds of testing process acquire considerable expenses and get more time which might be weeks or months. The various factors affect the quality of the video frames are blockiness, blurriness, color bleeding, falsy edges and chrominance mismatch and so on [3]. The video quality has been categorized by two main testing techniques such as Objective testing and Subjective testing. Objective testing can estimates human perception and judges the quality based objective metrics. The objective testing is finding based on mathematical logics or algorithms which are only performed with video images.The goal of objective Video Quality Assessment systems are Match visual performance (Human Visual System) in predicting quality, extraction of image features (brightness, contrast, edges, textures, color)computedfrom the reference and test videos and Compute motion information's.

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The subjective testing means viewer's providing their opinion on the video image quality [11]. The works explore measures of quality with the help of objective testing and software testing methods it presents the quality estimation through Subjective mode. The subjective mode defines visual perceptual quality score. In this work Absolute Category Rating (ACR), is used and it is a procedure to assess quality to compare with the defect rate.

2 Backgrounds of Video Quality Analysis

There are several types of VQA metrics exists to evaluate the quality of video. VQA metrics are proposed three different and related objective testing methods. Frame/Image Quality metrics are categorized into full-reference (FR), no- reference (NR) and reduced-reference (RR). FR metrics are appropriate for offline video quality measurement [11]. And it is considered a cause for using full reference metrics. The Full reference metrics measure imperfection between test video measures up with reference video. Usually requires accurate spatial and temporal alignment and calibration of luminance and color between the videos. FR compares each pixel and each frame of a referred test video. When new classes of visual distortions need to evaluate, the limitations be-come crippling there is no way to know how well an objective estimator will perform until there are subjectivetest results to com-pare it to [7].The tool VDRAT analyses video attributes for finding the edge defects blur and inter frame error. However, low-level content of visual importance sometimes called salient image features, which are used to improve IQA/VQA algorithms [3]. An inter frame is defined as brightness difference between the frames or the motion between two frames.

The work focuses on fault edge detection using canny edge detection algorithm. There are five different edge detection algorithms are available to work such as, Classical or Gradient based edge detectors, Zero crossing, Laplacian of Gaussian (LoG), Gaussian edge detectors and Colored edge detectors. These video analysis tools works with traditional edge detection and detect false edges, but high threshold fail to notice important edges [4].

Edge detection is a process of identifying and locating discontinuities and fundamental work in both the image processing and video processing areas. The discontinuities are unexpected changes in pixel intensity which characterize boundaries of objects in a scene. Particularly detect features in the input frame/image and extract quality details [2]. The goals of finding edges are to identify the brightness, sharpness or blurriness in any desired frames. In analysis the first phase is to estimate the sample frame quality using full reference metrics. List of VQA algorithms are available to measure objective quality such as, Structural Similarity (SSIM), Multi-Scale SSIM (MS-SSIM), Visual Signal to Noise Ratio (VSNR), Video Quality Metric (VQM), Visual Information Fidelity (V-VIF) [8]. In this work the PeakSignal to Noise Ratio or PSNR is used for estimating PSNR to compute Mean Square Error (MSE). PSNR measures the difference between the reconstructed video file and the Original video file [2][5]. The number of defected frames compare with the original frames. The Mean Opinion Score (MOS) calculated based on the PSNR. Table.1 shows PSNR value and MOS results [6]. The proposed tool performs the same concept through software quality metrics results.

Table 1. MOS based on PSNR

PSNR (dB)	MOS
>30	5
31 – 36.9 4	4
25 – 30.9 3	3
20 – 24.9 2	2
< 19.9 1	1

Test case effectiveness metrics measures percentage of defected frames and compared with the ACR Absolute Category Rating. ACR is one of the subjective testing techniques measured by number of subjects.

3 Analysis and Quality Estimation Process

The first step of process is, extraction of general attributes from input video is file size, type, duration, Frames per Second (FPS), bit rate, video resolution, audio type etc. The input video is converted into number of frames or images tool defined pixel type three component pixel (RGB pixel) and one component pixel (gray pixel). The process steps are given below:

Table 2. VDRAT Process steps

VDRAT STEPS:
Step 1: Load input as a video and reference video

Step 2: Extract quantitative information's from test video

Step 3: Convert input videos into N number of frames

Step 4: Extract qualitative information's from converted frames

a. Spatial data extraction

b. Temporal data extraction

Step 5: Test data evaluation

Step 6: Test Results Extraction

The table.2 displays Video process modules that pass. The processes are,

(a) The Analysis of the test video sequences is treated as input Frames. The frames are compared with the reference video sequences.

(b) The degradation of the test video sequences are treated as the low quality videos that finds each frames noise rate.

(c) In order to enable Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR) calculation [2], the original high quality test sequences is compared with the result sequences for reference. The coding artifacts analyze to, test the each frames Pixel values, Color values and Noise rate. The pixels are classified by using feature extraction method to get appropriate pixel properties, such as the intensity (gray-level), color, or local image characteristics calculated on the pixels'. When implementation starts, the brightness which is ranged from 0 to 255 as a value of specific pixel calculated for classification.

3.1 Test Input

This work also contains list of input parameters they are given be-low: -

input File( ) For load input video, filename ( ) Input file name. Test File Path ( ) - File Location. The purpose of file path is store extracted data in the declared file path. Ref File Path ( ) is another path stored process require data. get Image( ) for getting image or frame, into our process module. getHeight( ) and getWidth( ) for extract height and width of the test frame and estimate total number of pixels in the frame which data type is Buffered Image, one of the parameter set for asses color difference between the frames they are, totalRed data type is int, totalGreen data type is int, totalBlue data type is int, maxRed data type is int, maxGreen data type is int, maxBlue data type is int, worstRedX data type is int, worstRedY data type is int, worstGreenX data type is int, worstGreenY data type is int, worstBlueX data type is int, worstBlueY data type is int, MaxDistance data type is double, maxX data type is int, intmaxY data type is int, totalDifference ( ) for find the difference between the test input.

3.2 Quality Assessment

1. Frame Rate based quality assessment: The quality video frame per second or frame rate between 20 to 25 is normal otherwise less than or greater than which means the perceptual quality is slow or fast. If the frame rate is more than 35 viewers, it cannot identify visual objects.
2. Objective testing: PSNR estimation is compared with proposed defect rate which refers table.1 values.
3. Subjective testing: Total number of defected frames occurred in whole video which is comparing the defect Percentage on subjective testing method.
4. Edge taper function: Edge taper function is used for find the ringing effect in frame deblurring methods [10].
5. Criteria for Test Defected Frames:

(i) If the defect rates between 1 to 20, (1≤defect rate≥20) the quality is Excellent

(ii) If the defect rate between 21 to 40, (21≤defect rate≥40) the quality is good

(iii) If the defect rate between 41 to 60, (41≤defect rate≥60) the quality is fair

(iv) If the defects rate between 61 to 80, (61≤defect rate≥80) the quality level Poor

(v) If the defect rate between 81 to 100, (81≤defect rate≥100) the quality level is unacceptable

3.3 Merits and Demerits of VDRAT Tool

The main advantage of proposed tool is Applicable for different platforms and analyzes quantitative factors of the test input. The VDRAT analyzes quantitative video facts also which is applicable on web. The disadvantage is file format which is predefined and analyse only visual objects and its edges

4 Edge detection and Defect rate calculation

MSE and PSNR is a metric which calculates noise, X and Y are number of pixels in the original key frame, and XY is an image objects associated pixels. Xi and Yi compared frame pixel values. Figure.1 shows the original and compared test input frames for measure the quality of the video frames. Xi,Yi is noise image pixels.

$$\text{MSE(x, y)} = \frac{1}{N}\sum_{i=1}^{n}(Xi - Yi)^2 \quad (1)$$

X=1,2,3,…N , y=1,2,3,…N and XY=Original ImagePixels; Xi=1,2,3,…N &yi=1,2,3,…N; XiYi=Noise Image Pixels; (img1&img2=0)=∞

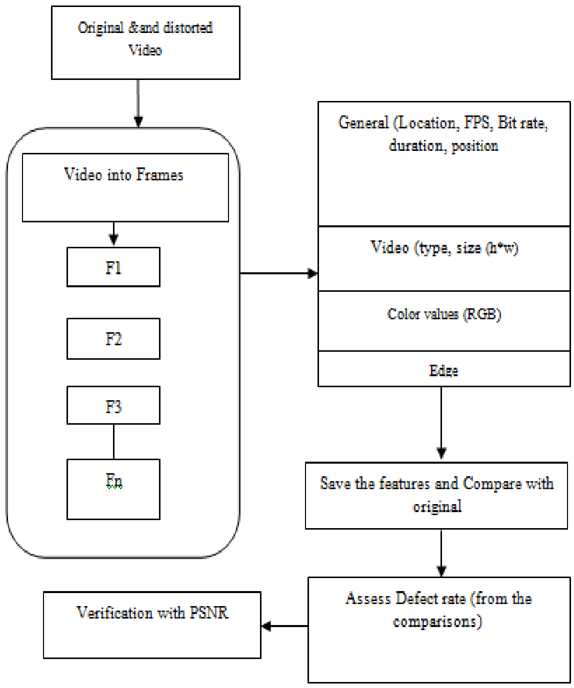

Fig 1: Functional View of the Video Quality Analysis

4.1 Edge Detection Process

The analysis tool tests the false edges and blurness in the video frames. The purpose of canny edge detection algorithm is used for detecting both strong and weak edges from to other edge-detection methods [3].

4.2 Simulation Parameters

The analysis process applied software metrics to estimate video fault rate detection or fault detection. Quality of the product are number of defects found in a product, the objective of analysis is to improve the products quality. The software defect density evaluation method measures defect rate based on each unit or individual fames in test video as follows, [10].In software's Thousand lines of code is treated as KLOC here, it is assigned in video frames or pixels in a frame.

$$\text{Defects per KLOC} = \frac{\textit{Total Defects Found in the Product}}{\textit{Total Executable AMD lines of code in KLOC}}$$

The total number of pixels in test frame is assigned instead of Kilo Lines of code (KLOC) and the differences or detected false edges are applied on Total Defects Found in the Product.

$$\text{Percentage of Defect} = \frac{\textit{Total number of Fault Frames}}{\text{Total number of frames}} * 100$$

The product is test video the total number of pixels in input frame represents for Total Executable AMD lined of code in KLOC. The method is applied on four test videos for extracting test input frames and obtained computation results. The defect level is verified through video quality metric PSNR. The following Table.3 displays the Experimental results of the test videos.

The fish video contains 29 defect frames, defect percentage is, 21.0145 and ACR rating of the video is Good. The second test video contains 346 defect frames, 66.4107defect percentage is, and ACR rating of the video is, Poor. Percentages of defect for third and fourth videos are 3.663 and 38.7755respectively.

Table 3. Test Quality of the Frame - Comparison of original and noise frames

Video name	Size (Height X Width)	Total number frames	Number of defected frames	% of defect	PSNR results
sea	160X120	138	29	21.0145	23.2256
Robot	320X290	521	346	66.4107	7.3133
Nature	240X190	273	19	6.9597	26.5656
Moving Car	540X460	49	1	2.0408	32.4990

The ACR rating is excellent to Unacceptable, this work finds the PSNR to all the test videos and comparison of defect percentage has been made PSNR's results are highly related. From this calculation, Video defect rate estimation is displayed in Table.3 the quality is quite opposite to the correlation of defects. The ACR rating also applied in the reverse. In this work ACR rate is applied to get the quality rate. The Table.1 indicates the ACR rate and Table.4 illustrates the various defect rates according to the Table.1 ACR rate.

Table 4.proposed quality assessment table

% of Defect Rate	ACR (Quality Rate)
1≤20	5(Excellent)
21≤40	4(Good)
41≤60	3(Fair)
61≤80	2(Poor)
81≤100	1(Unacceptable)

The screenshots of the execution process of defected frame in Figure.2 The edge difference between the original and reference frame is displayed in Fig2.

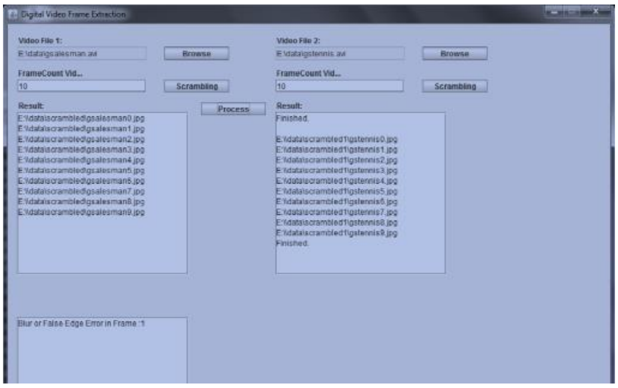

Fig 2: Result Page on Defect Edge or Fault Edge

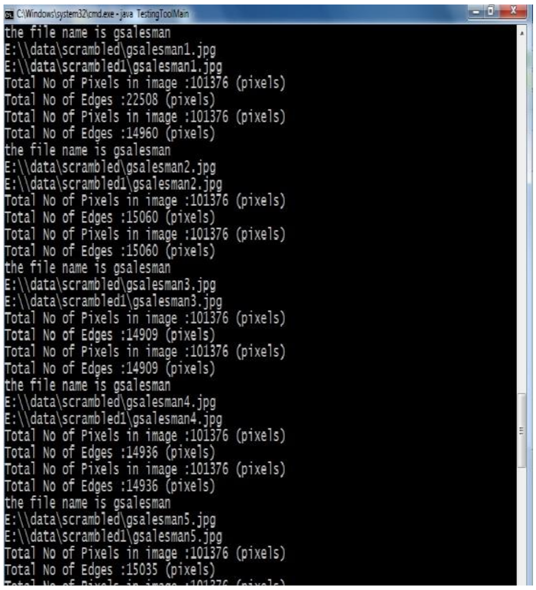

Fig 3: Edge difference between Test and Reference Frames

5 Results and Discussions

The analysis and defect detection have been found with the results. The defect rate is getting from the four different test videos with various screen size and number of frames in input file. The defect rate is identified by the label Defect Rate and quality rate is identified by the label Quality Rate. The results for VDRAT is shown in the form of graphical representation in Fig.4 which represents the defect rate and quality rate of input test videos, such as tv1, tv2, tv3 and tv4. The result shows that the percentage of defect rate is extremely high since quality rate is low. In general, when the defect rate is high automatically the quality rate will be low. The table.2 depicts the defect rate by the proposed tool of VDRAT using Defects per KLOC from software metrics. The comparisons of the proposed work has been made with one of the objective testing metric called PSNR for verification purpose to realize the main objective of thiswork.

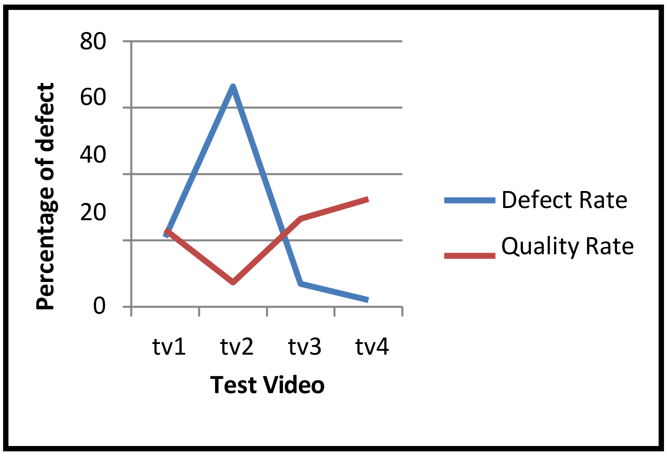

Fig4: VDRAT results

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