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A Novel Algorithm for Contrast Enhancement for Color Videos

Shaik Sharmila (M.Tech) [1] , & . Mary Junitha (Prof.) [2]
[1,2] NRI Institute of Technology,Visadala,Medikonduru,Guntur,Andhra Pradesh- 500100,INDIA,
sharmilanoorjhan@gmail.com[1] mmjunitha@gmail.com[2]

ABSTRACT

Existing methods are not giving satisfactory results for contrast enhancement as there is lot of parameters which should get match with required implementation algorithm. This implementation is totally based on the famous image processing tool contrast enhancement technique for enhancing the quality of colour videos captured under different deformations such as poor illumination and varying environmental conditions,etc. As we know the Video is nothing but frames of images, we will convert video into frames of images. The sequences of Images are converted from RGB color space to HSV colour space where we can get enhancement and get back to the RGB color space. The basic Class Limited Adaptive Histogram Equalization (CLAHE) is also used for enhancing the luminance component (V). Discrete Wavelet Transform(DWT) which is very famous transform techniques applied to the Saturation (S) components, after that the decomposed approximation coefficients are changed with the help of mapping function which is got with the help of scaling triangle transform. The enhancement in the S component can get by with the help of Inverse Wavelet transforms(IDWT). The image obtained after this step is then converted back to the original RGB images. Subjective (visual quality inspection) as well as objective parameters such as Peak-signal-to-noise ratio (PSNR), Absolute Mean Brightness Error (AMBE) and Mean squared error (MSE)) were used to check the performance of the system.The algorithm implemented can be compared with existing state of art techniques which will show the robustness of proposed work.The proposed work will give the better results with comparision. The same implementation is applied for video and we will get the improved contrast enhancement for real time videos. Video is nothing but frames of images.

Keywords—Contrast Enhancement; Class Limited Adaptive Histogram Equalization (CLAHE), Video processing, frames of video.

I.INTRODUCTION

Contrast is the difference in luminance or depth stage among gadgets or regions in an image. If the evaluation is too low, all pixels are a mid-coloration of grey making the items to fade into every different. Hence, low comparison reasons lack of information in a few areas inside the image, even as proper contrast makes gadgets or scenes depicted in an photograph distinguishable and visually interpretable for human and machine evaluation. Many algorithms for attaining comparison enhancement were evolved; among them is histogram equalization method that is attractive because of its simplicity.

Other colour enhancement strategies had been proposed primarily based on histogram equalization [3,4], those also encompass multiscale strategies [5] and different hue protection evaluation enhancement schemes [4]. Earlier works have additionally proven that the overall performance of HSV shade space is ideal in colour improvement [1]. Hue protection methods maintain the Hue consistent to keep away from the hassle of coloration moving, while both simplest the Luminance (V) element or both Luminance (V) and Saturation (S) components are changed to make the photo smooth and brilliant.

Compared with distinctive models which include CIE LUV colour location and CIE Lab colour place, it's far less hard to govern the Hue thing and nonetheless keep away from colour transferring in the HSV colour vicinity. Therefore, this artwork proposes a Hue maintaining set of rules, which uses a derived mapping feature to regulate the Saturation additives, and CLAHE for Luminance components.

The observed picture is the multiplication of components, specifically, illumination and reflectance, that are defined as intrinsic photos in [1]. In a real scene, the illumination aspect is generally non uniform and has a excessive dynamic variety, whereas the reflectance famous the info of the items within the picture. A digital acquisition device inclusive of a consumer digital camera regularly suffers from varying mild conditions because of its a good deal narrower dynamic variety than that of the illumination. The captured photo may want to contain each underexposed and overexposed areas and has low local contrast in both areas. Therefore, an enhancement algorithm that specializes in addressing the illumination trouble is required to decorate the image's visible nice. There are numerous kinds of comparison enhancement algorithms which have been proposed, including histogram equalization [2], [3] and perceptual enhancement [4], [5], among others. A huge set of those algorithms are inspired with the aid of Retinex, which was at the start a colour fidelity model that mimicked the color look of the human visual device [6].

Algorithms of this kind generally decompose the image into a low frequency issue denoted as illumination and a high frequency factor denoted as reflectance. The nearby evaluation is more suitable by way of compressing the illumination or sincerely extracting the reflectance because the final result. Among the Retinex-stimulated algorithms, a broadly used version is the center/surround algorithm [7].This type of algorithm estimates a smoothed version of the image and subtracts it from the authentic photograph to improve the comparison. The strategies range in the kinds of filters that are adopted to blur the photograph. The SSR (unmarried-scale Retinex) [7] and MSR (multi-scale Retinex) [8] utilize a Gaussian filter to clean the image.

II.LITERATURE SURVEY

A modified approach is the bilateral filter out, whose weighting coefficients are a aggregate of spatial closeness and pixel value similarity. This method preserves the edges nicely within the illumination and avoids halo artifacts within the improved end result. Recently, Wang designed a "shiny-skip" clear out to estimate the illumination, in which the weights have been calculated via the frequency within the spatial domain of the connection between the relevant pixel and its neighboring pixels.

Another set of Retinex-like enhancement algorithms is based totally at the variational framework. These algorithms impose assumptions on every the reflectance and illumination, and they reap both components by way of using solving a quadratic optimization trouble. The divergence of those fashions mainly includes splendid norms for the penalty phrases and awesome constraints. The preliminary work is Kimmel's L2-primarily based definitely variant model, which makes use of sparsity phrases on The illumination and reflectance in addition to a fidelity term on the illumination. Ng et al. Proposed a variational version that imposed a TV (standard version) time period on the reflectance .

Recently, Fu et al. Proposed a variational version for photo enhancement, where the logarithmic transformation for the illumination and reflectance changed into abandoned to gain a better degree of the rims. The algorithm become green and preserved the threshold information well. To attenuate the affect of illumination unevenness and monitor the information in the underexposed and overexposed regions, the important system is to estimate the illumination and compress it.

III.PROPOSED WORK

3.1 Colour Space Conversion

The whole set of rules for the image enhancement method is obtainable inside the glide machine below and the flowchart in Figure 1.

Algorithm for implementation is ,

1) Load a color Image(RGB Image)
2) Change the color transform from RGB to HSV color space.

3) First of all apply a robust Discrete Wavelet Transform to saturation (S) component
4) After that use a derived mapping function which is used to regulate approximate coefficients.
5) Again Reconstruct the S coefficient by Inverse Discrete Wavelet transform.
6) The luminance (V) element should be enhanced for the usage of CLAHE.
7) Combine all the components like H, new S component, as well as V components to get the enhanced HSV image.
8) Convert back the HSV image to RGB image.

Conversion RGB image to HSV image is achieved through equations (1) to (5).

$$R^{'} = \frac{R}{255}: G^{'} = \frac{G}{255}: B^{'} = \frac{B}{255}: \qquad (1)$$

If,

$$C_{max} = max(R^{'}, G^{'}, B^{'});\ C_{min} = min(R^{'}, G^{'}, B^{'});\ and\ \Delta = C_{max} - C_{min} \quad (2)$$

Then,

$$H = \begin{cases} 60° \times \left(\frac{G^{'} - B^{'}}{\Delta} miod6\right) & , C_{max} = R^{'} \\ 60° \times \left(\frac{B^{'} - R^{'}}{\Delta} + 2\right) & , C_{max} = G^{'} \\ 60° \times \left(\frac{R^{'} - G^{'}}{\Delta} + 4\right) & , C_{max} = B^{'} \end{cases} \qquad (3)$$

$$S = \begin{cases} 0 & , \Delta = 0 \\ \frac{\Delta}{C_{max}} & , \Delta = 0 \end{cases} \qquad (4)$$

$$V = C_{max} \qquad (5)$$

Inverse conversion to RGB colour space after enhancement is achieved through equations (6) to (12).

$$h_i = \left(\frac{H}{60}\right) mod6, \quad (6)$$

$$f = \frac{H}{60} - h_i \quad (7)$$

$$p = v \times (1 - S), \quad (8)$$

$$q = v \times (1 - f \times S), \quad (9)$$

And $t = v \times (1 - (1 - f) \times S)$ (10)

For each color Vector (r, g ,b),

$$(r, g, b) = \begin{cases} (v, t, p), & if h_i = 0 \\ (q, v, p), & if h_i = 1 \\ (p, v, t), & if h_i = 2 \\ (p, q, v), & if h_i = 3 \\ (t, p, q), & if h_i = 4 \\ (v, p, q), & if h_i = 5 \end{cases} \qquad (11)$$

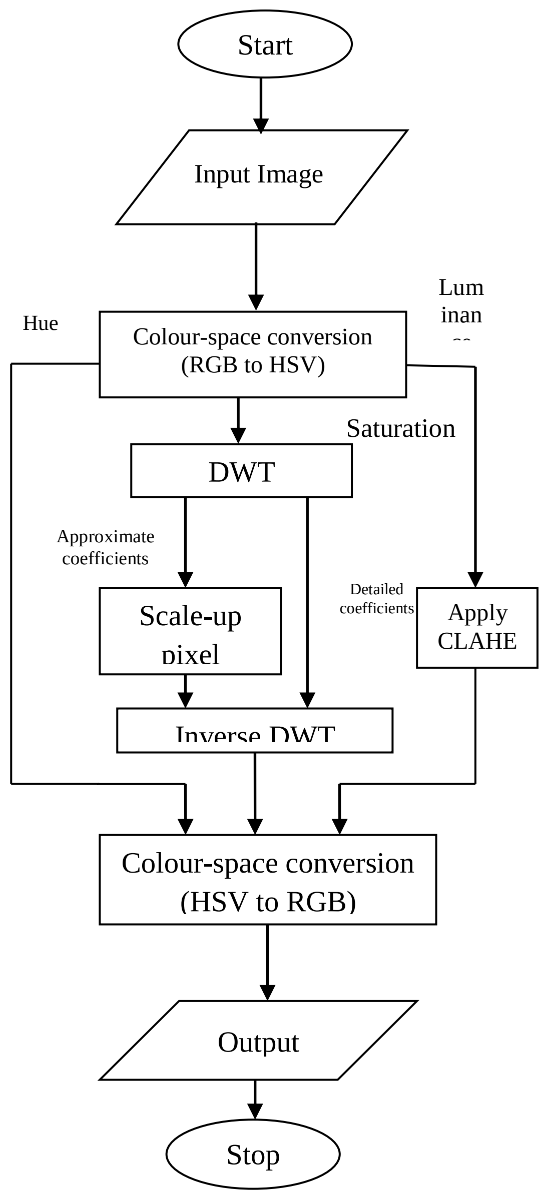

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Fig3.1.Block Diagram of image enhancement algorithm

$$R = r \times 256, \quad G = g \times 256, \quad B = b \times 256, \quad (12)$$

3.2 Contrast Enhancement of Saturation Component.

Discrete Wavelet Transform became carried out to the Saturation Component of the photograph. An enhancement set of rules (derived mapping function) was applied to the approximate element of the wavelet decomposition. Wavelet remodel of Image I(x,y) produce S(x,y), which is similarly decomposed into approximate A and certain components D as proven in equation (13)

$$S(x,y) = \sum_{j=0}^{n-1} A_j \emptyset_{jn}(x,y) + \sum_{j=0}^{n-1}\sum_{k=0}^{n} D_{jk} \emptyset_{jk}(x,y) \qquad (13)$$

Where $\emptyset$the scale is function and $\hat{}$ $\emptyset$ is the wavelet function. $A_j$are approximate coefficients and $D_{jk}$are detail coefficients.

Mapping function for change of the Saturation aspect is derived from two equilateral triangles, in which one is a scaled model of the other as shown in Figure 2. The minimum fee of the decomposed sign is mapped to the base of the 'smaller' triangle, while the maximum fee is mapped to the tip of the equal triangle.

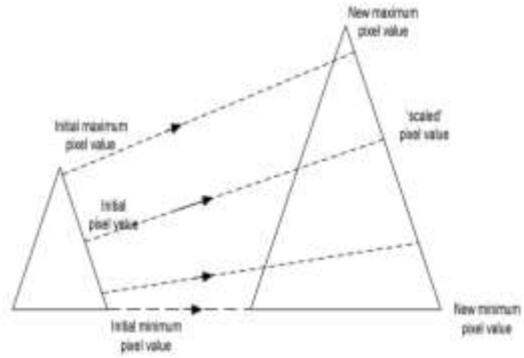

Fig. 2.Scale-up triangle model

$$New\ min = (oldmin * 2.5289);$$

$$newmax = (oldmax * 0.9)$$

$$For\ i = 1 to\ H; and\ j = 1\ to\ W$$

$$new\ A(i,j) = newmax - \frac{(newmax - oldA(i,j)) \times (newmax - newmin)}{oldmax - oldmin} \quad (14)$$

Where I and j represents the row and column respectively, which stands for the location of a particular approximate component of a pixel.

$$S^{'}(x,y) = \sum_{j=0}^{n-1} A_j^{'} \emptyset_{jn}(x,y) + \sum_{j=0}^{n-1}\sum_{k=0}^{n} D_{jk} \emptyset_{jk}(x,y) \quad (15)$$

The stronger Saturation (S) value is acquired through inverse wavelet transform of the new approximate and authentic decomposition coefficients.

3.3 Contrast Enhancement of Luminance Component:

CLAHE turn out to be observed for the enhancement of the V element in the HSV colour area. The V thing photo is split into eight×eight tiles. The clip-limit used is 0.01. Uniform distribution is used as the histogram form for the picture tiles.

The expression of modified gray tiers for standard CLAHE technique with Uniform Distribution can be given as

$$g = [g_{max} - g_{min}] * P(f) + g_{\min} \quad (16)$$

$$Where\ g_{max} = Maximum\ Pixel\ Value$$

$$g_{min} = Minimum\ Pixel\ Value$$

$$g = comuted\ Pixel\ Value$$

$$P(f) = cummulative\ Probability\ Distribution$$

3.4 Performance Evaluation

3.4.1) Absolute mean brightness blunders (AMBE) is the distinction between average depth level of the unique and more suitable picture and is given as

$$AMBE = |E(y) - E(X)| \quad (17)$$

Where E(X)= common intensity of input photograph E(y) =common intensity of enhanced photo.

Low AMBE indicates a better brightness upkeep of the method.

3.4.2) Mean-squared-error (MSE) is given as

$$MSE = \frac{1}{MN} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} \Big[\big(r(i,j) - r''(i,j)\big)^2 + \big(g(i,j) - g''(i,j)\big)^2 + \big(b(i,j) - b''(i,j)\big)^2 \Big] \quad (18)$$

Where $r(i,j), r''(i,j),\ g(i,j),\ g''(i,j), b(i,j), b(i,j)$ Are photograph pixels of unique and more desirable image of length (M*N) that corresponds to purple, green, and blue respectively. It is the common of the squares of the distinction between the unique and improved photograph. The lower the MSE the better the approach.

3.4.3) Peak-signal-to-noise-ratio

(PSNR) is used to evaluate the nice of the reconstructed photograph. PSNR is measured in decibels (dB) and is given by using:

$$PSNR = 10log_{10} \frac{R^2}{MSE} \quad (19)$$

Where R=255 for an 8-bit /magnificence eight photo and R=1 for a double-precision photo. The better the PSNR cost, the higher the reconstructed image.

Video Contrast Enhancement

Video enhancement trouble can be formulated as follows: given an input low pleasant video and the output excessive satisfactory video for precise packages. How are we able to make video greater clearer or subjectively better? Digital video has end up an vital part of everyday life. It is well-known that video enhancement as an active subject matter in computer vision has obtained a lot attention in latest years. The intention is to enhance the visual look of the video, or to provide a "better"rework illustration for destiny automatic video processing, which includes evaluation, detection, segmentation, and recognition. Moreover, it allows analyses historical past facts that is critical to apprehend object behavior without requiring high-priced human visual inspection. There are several packages in which virtual video is acquired, processed and used, inclusive of surveillance, trendy identification verification, visitors, criminal justice systems, civilian or military video processing et al. Video enhancement strategies involve processing an image/body to make it look better to human visitors.

IV.EXPERIMENTAL RESULTS AND DISCUSSION

(A) **Experimental Results For Image**

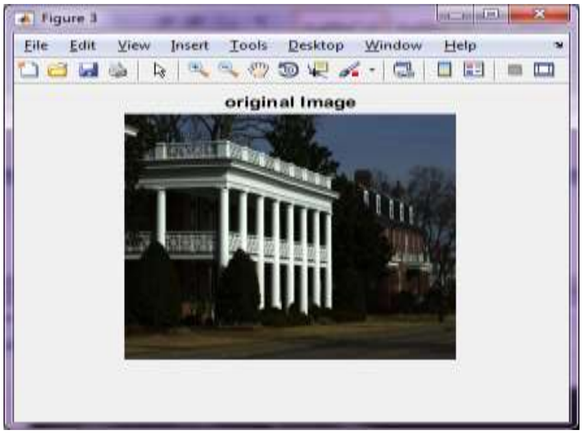

Fig1: Original Image

Above we showed an original image for which we have to improve contrast.

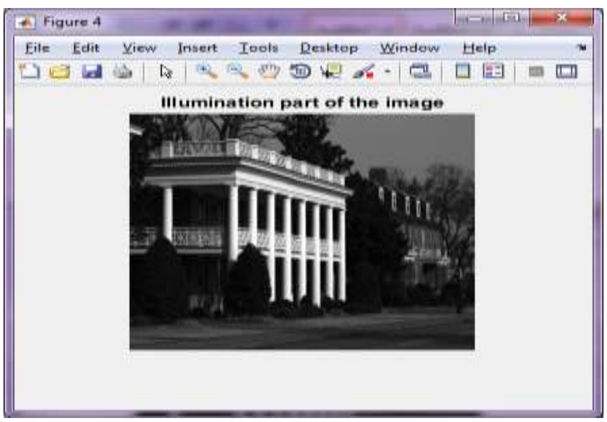

Fig2: Illumination part of the image

From given image we calculated the illumination part of image.

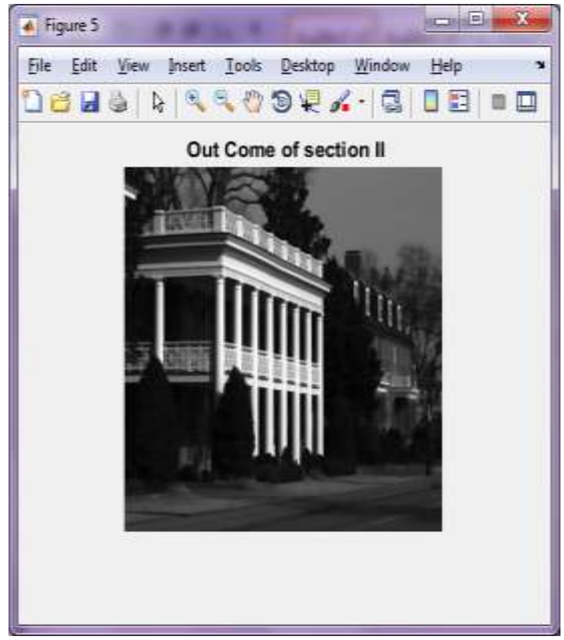

Fig3: Out Come of Section 2

In above section we are getting outcome for section 2 mentioned in paper.

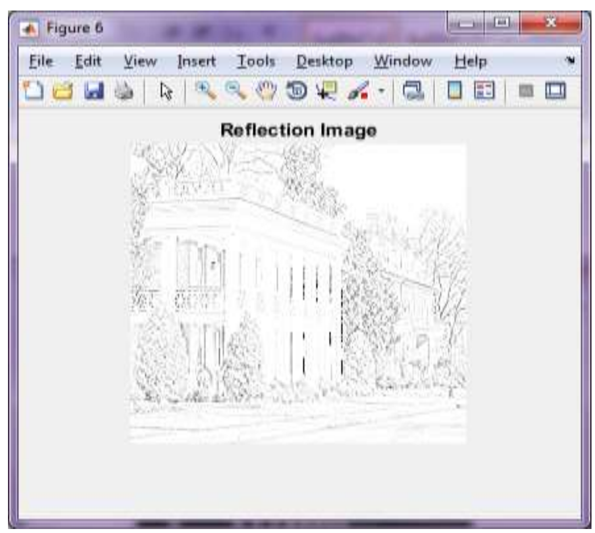

Fig4: Reflection Image

Above we showed reflection image for a given image.

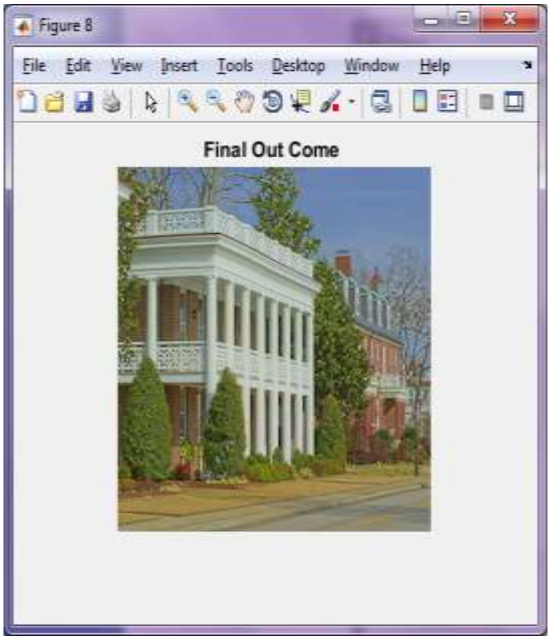

Fig5: Final Out Come

Final output we got by proposed work is shown above,which is more efficient than any other method.

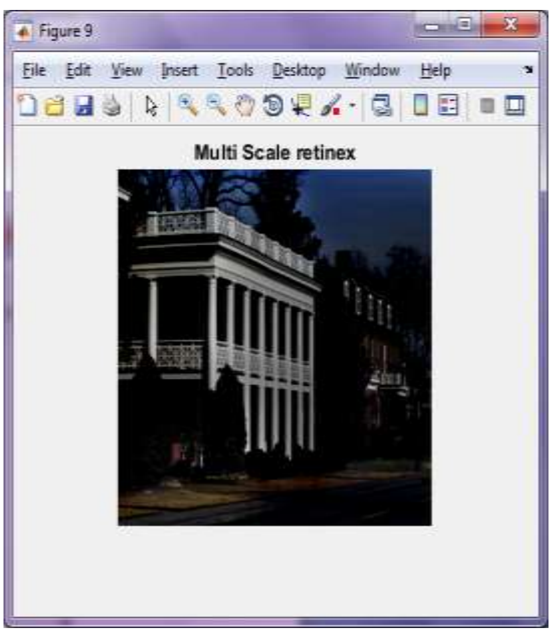

Fig6: Multi scale Retinex

The above output shows that the multi scale retinex output.

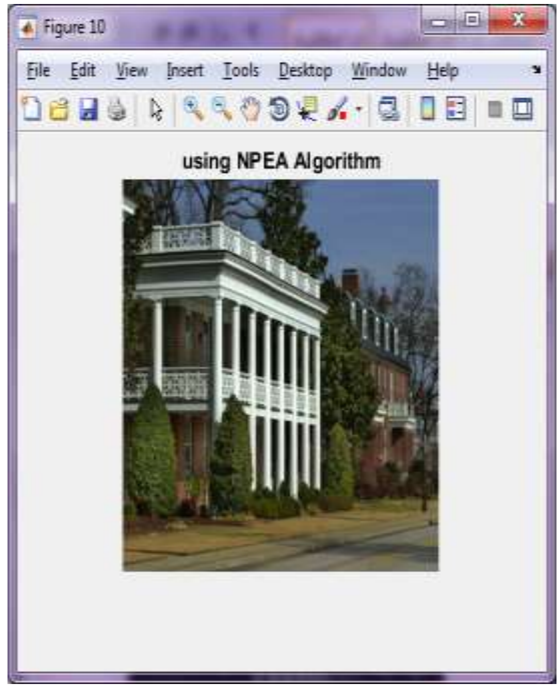

Fig7: Using NPEA Algorithm

Above figure shows the NPEA algorithm output.

(b) Experimental Results For Video:

Fig1: Input Video

Same thing we applied for video and we did analysis. For video input also this method works more efficient.

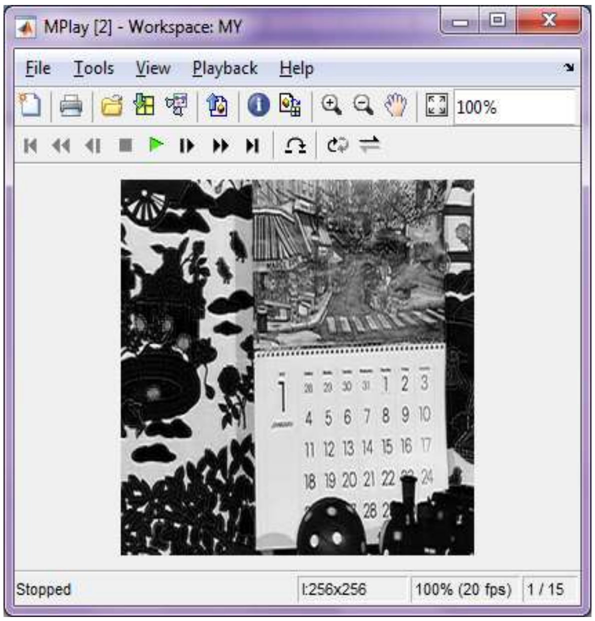

Fig2: Embedded Data video

Above figure shows the video after data embedding.

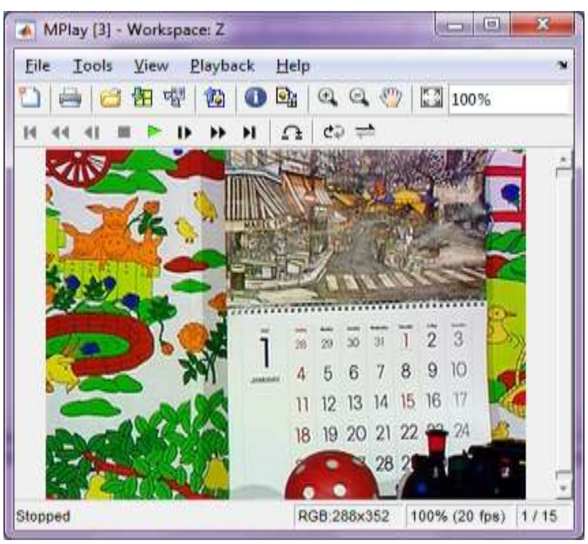

Fig3: Improved contrast Video

Finally we get the output Video having better contrast.

V.CONCLUSIONS

In this Paper, a set of rules for color photograph enhancement has been supplied. Modification has become finished in HSV color space, even as enhancement finished in the frequency area. The Hue aspect is preserved (unchanged), luminance modified the usage of CLAHE, on the equal time as Saturation additives have been up-scaled the usage of a derived mapping function on the approximate additives of its discrete wavelet rework. The technique achieved exceptional while in comparison with outputs of HE and CLAHE strategies, thru protection of image great and accelerated dynamic style of picture brightness. The technique produced pictures with the lowest MSE AMBE, and highest PSNR. In our destiny paintings, we are hoping to introduce adaptive noise elimination, this is expected to provide a higher end result. Same implementation is applied to video and checked the results. With the help of both subjective as well as objective analysis we can show that the contrast of image is improved to great extent. The same implementation is used for Video contrast enhancement. Because, video is nothing but frames of images.So mostly we will work on frames of images for whole implementation. Subjective as well as objective implementation will prove the proposed method is robust and efficient.

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