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# Low Light Video Enhancement

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**ABSTRACT:** Today, we are in a society where almost everybody familiar with the word “Video”. With this increased utility researches have been done over several decades and there have been notable capability improvements in Digital cameras correspond to resolution and sensitiveness. Despite these improvements the modern digital cameras are still limited in capturing Good quality ofvideos because of factors such as haze, low light, brightness, contrast, blur, or artifacts. One of the most affecting factor is low-light conditions which limits the digital camera by capturing high dynamic range frames**.** Hence in this paper we are proposing a method for enhancement of low light video .In this method noise reduction is done by using simple filtering algorithms and then the contrast enhancement is carried out so that details are brought out and provide better visibility to the video for viewer .This process is done on real time low light video in frame by frame manner.

**KEYWORDS**:Low light video;filtering algorithm; contrast Enhancement; real time video.

## I. INTRODUCTION

Digital video has become essential in our everyday lives. With the rapid development of communication technologies, video has played a significant role in multimedia communication systems and heavily trust upon in many forensic applications such as crime scene reconstruction, questioned documents, and bio-metric analysis including facial and finger print identification also.Therefore the video enhancement is essential to maintain the quality of video at an acceptable level in different application environments .Video enhancement is applied every field where video is to be understood and analyze .

The main purpose of video enhancement method is to maximize the visibility of low light video. This method are not just related to maximize the visibility of the video but also to provide good quality result in minimum processing time as we are working with real time video. In this method noise reduction is done by using simple filtering algorithm such as Gaussian & Adaptive median filtering method and then the contrast enhancement is carried out so that details are brought out and provide better visibility to the video for viewer .

## II. RELATED WORK

In [1] proposed methods for removal of noise motion adaptive temporal filtering . By adaptive adjustment of RGB histograms causes the increment in Dynamic range of denoised video. Ultimately, remaining unwanted element which is noise can be abstracted by using Non-local means (NLM) denoising. In [2] introduces a method which based on adaptive enhancement and noise reduction for very dark image sequences with very low dynamic range. With low dynamic range is proposed general method for noise reduction and contrast enhancement in very noisy image data . In order to preserve and enhance fine details and prevent motion blur the Uncreased substance that automatically adapt to the local spatio-temporal intensity structure in the image sequences are create .In color image data, the chromaticity is restored and demo of raw RGB input data is performed at the same time along with the noise reduction. The method is very general, contains few user-defined quantity and has been developed for efficient symmetric data processing using a GPU.In [3] the proposed algorithm is of the three stage, in the first and the third stages, the well-known Non-Local Means (NLM) method for denoising use: it is well adapted for the application, leading to the definition of a novel NLM tool. The middle stage execute a custom tone modification specifically design at extending dynamic range of poor light videos. The overall approach transforms very dark videos into more watchable ones.In [5] presents the

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algorithm mechanically find the predominate source of change, then depending on whether it is low lighting, fog or others, a corresponding pre-processing is applied to the poor light video, followed by the kernel enhancement algorithm . Temporal and spatial repetitiveness in the video input are used to support real-time processing and to improve temporal and spatial property of the output video.

## III. PROPOSED METHOD

In this paper we are implementing the obtainable method of video enhancement, which can be made better enhancement of video taken in poor lightning conditions. Desired outcome of the process is to enhance video. The block diagram of proposed method is as follow

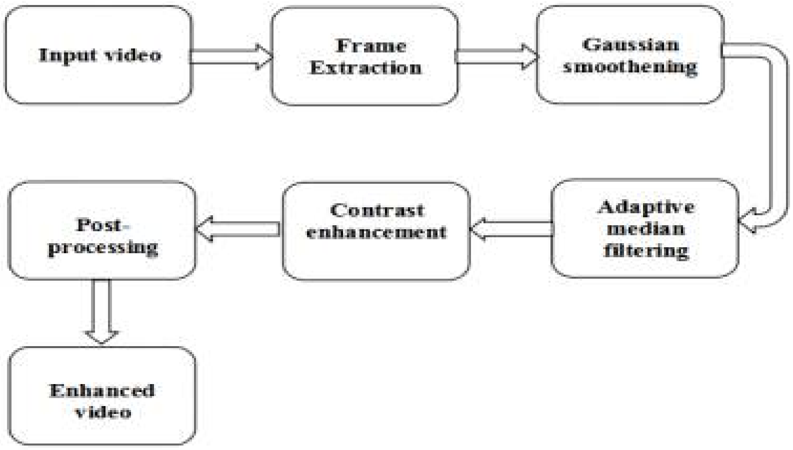


Fig.1 : Block diagram of proposed method

A. ***INPUT VIDEO:***

The input to the system on which all the method are apply is captured by using two different way as :
(i) By using integrated web camera(Webcam) .
(ii) By using the external web camera (Webcam) .
As we are implementing the real time video enhancement system the input video captured continuously.

B. ***FRAME EXTRACTION::***

Next is the extraction of frames for enhancement it at this point detection of frames is done to find out, whether the frame is of day condition video is or it is of night condition .According to type of frame the classification of video is done and after which the enhancement is applied to night condition video only.

-Plot the histogram of the input frame
-Determine the mean of the RGB intensity distribution ‘m’
-Compare this mean with the pre-defined threshold to decide, whether the frame is of day condition or Night condition.
- if m > th Then the frame is of day condition Else the frame is of night condition.
- threshold th is predefined.

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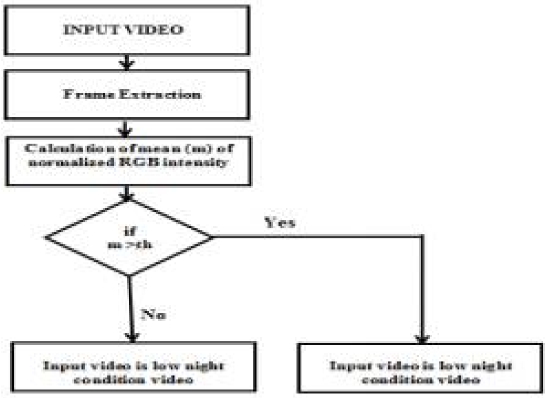


Fig.2: Flow chart to detect the type of input frame

***C . GAUSSIAN SMOOTHING:***

Primary level of noise reduction is completed by Gaussian smoothing.It is widely used result in graphics code, generally to cut back image noise.It is conjointly used as a pre-processing stage in computer vision algorithms so as to boost image structures at totally different scales Mathematically, applying a Gaussian smoothing to a picture is that the same as convolving the image with a Gaussian operate. this can be conjointly called a two-dimensional Weierstrass remodel.The Gaussian smoothing operator may be a 2-D convolution operator that's used to smoothing pictures and take away noise applying a Gaussian smoothing has the result of reducing the image's high-frequency components; a Gaussian smoothing is so a low pass filter as we are dealing frames thus 2-D, an isotropous (i.e. circularly symmetric) Gaussian has the form:

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

The idea of Gaussian smoothing is to use this 2-D distribution as a `point-spread' operate, and this can be achieved by convolution. Since the image is hold on as a group of separate pixels we'd like to supply a separate approximation to the Gaussian operate before we will perform the convolution. In theory, the Gaussian distribution is non-zero all over, which might need an infinitely large convolution kernel, however in practice it is effectively zero over concerning three standard deviations from the mean, and then we will truncate the kernel at this point. during this method we have a tendency to considered 3 by 3 kernel with variance σ =0.5 Figure 3 shows an acceptable integer-valued convolution kernel that approximates a Gaussian with a σ of 0.5.It is not obvious a way to choose the values of the mask to approximate a Gaussian. One may use the value of the Gaussian at the middle of a component within the mask, however this is not correct as a result of the value of the Gaussian varies non-linearly across the pixel. we integrated the value of the Gaussian over the entire pixel. The integrals are not integers: we rescaled the array so the corners had the value one. Finally, the 16 is that thetotal of all the values within the mask

| | | |
|---|---|---|
| 1 | 2 | 1 |
| 2 | 4 | 2 |
| 1 | 2 | 1 |

*1/16

Fig.3: 3×3 Gaussian kernel

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Once an appropriate kernel has been calculated, then the Gaussian smoothing will be performed using standard convolution strategies. The convolution will really be performed fairly quickly since the equation for the 2-D identicalGaussian shown above is divisible into x and y parts. so the 2-D convolution will be performed by 1st convolution with a 1-D Gaussian within the x direction, then convolution with another 1-D Gaussian within the y direction.The degree of smoothing is decided by the standard deviation of the Gaussian.The Gaussian outputs a `weighted average' of every pixel's neighborhood, with the average weighted a lot of towards the value of the central pixels.

### *D. ADAPTIVE MEDIAN FILTERING:*

After the Gaussian smoothing the noise reduction will done by using the adaptive median filtering methodology . it's use to get rid of impulse noise from the from the frame. The adaptive Median Filter is intended to eliminate the issues faced with the standard median filter. such as the standard median filter is unable to differentiate between smaller details and noise therefore each of them are remover that results into blur output that is undesirable therefore we tend to move towards the adaptive median filter .In the adaptive Median Filter, the scale of the window surrounding every pixel is variable in line with the value is an impulse, then the scale of the window is expanded. Otherwise, further process is finished on the a part of the image inside the present window specifications. process the image primarily entails the following: the middle pixel of the window is evaluated to verify whether it's an impulse or not. If it's an impulse, then the new value of that pixel within the filtered image are going to be the median value of the pixels in that window. If, however, the middle pixel isn't an impulse, then the value of the middle pixel is preserved within the filtered image. Thus, unless the pixel being considered is an impulse, the gray-scale value of the pixel. If the median value is adequate to the minimum or maximum value, then it's deemed to be an impulse. during this case a pixel with its value between the minimum and maximum values is looked for, ranging from the immediate neighborhood of the median position. once it's completed that all pixels within the window are impulses the median is computed by increasing window size Smax .

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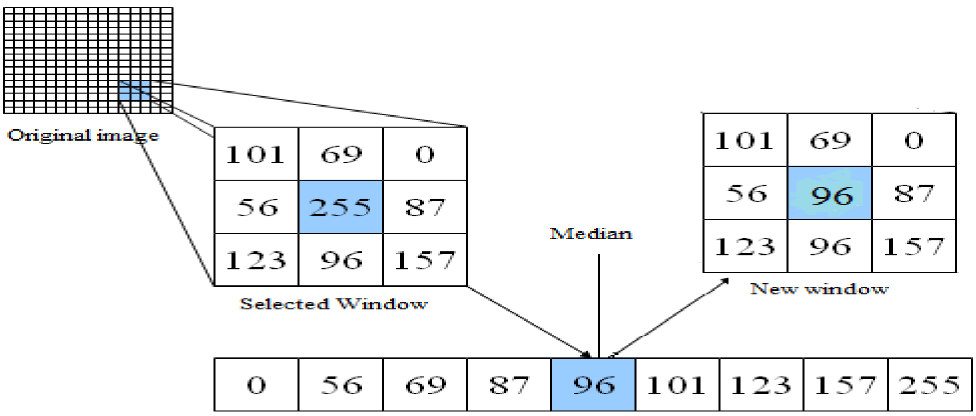


Fig.4 : Adaptive median filter with Sxy=3

Adaptive median filter changes window size i.e changes size of Sxy (the size of the neighborhood) during operation. the values increase in ascending order 3,5,….Smax

The operation of adaptive median filter is as follow

-Corp region of neighborhood

-Sort the value of the pixel in region

-Find out the median by considering the M×N mask.

-Replace the corrupted pixel with the median value.

Hence by applying such method to the frame new frame is obtained with the reduction of impulse noise and distortion along the boundary is also reduced like excessive thinning and thinking of object boundary

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### *E. WEIGHTED THRESHOLD HISTOGRAM EQUALIZATION:*

The next stage is contrast enhancement. After the noise is reduced, we amplify intensity of low-light video by the third block which nothing but the contrast Enchantment in which the applied input is enhance by some different methods . In This process is to adjust the local contrast in different regions of the image so that the details are brought out. The general idea adopted by the WTHE method is to modify the histogram before equalization is conducted. Such modifications reduce visual artifacts. During the video enhancement the impulse noise in the frames is also increased .
To avoid this impact, the improved frame is gone through a filter. In digital signal and video processing an frame is usually corrupted by noise in its acquisition or transmission. Noise is undesirable data that contaminates an image. that the typical filtering techniques are used to eliminate the noise and to preserve the sides. probability density function (PDF) is approximately obtained by

$$P(k) = \frac{n_k}{N}, \qquad \text{for } k = 0, 1, \ldots, L\text{-}1$$

In our proposed enhancement method, we perform HE based on a modified histogram. We replace the original PDF P(k) by a weighted threshold PDF Pwt(k),For a given digital image F(i, j) with N pixels and a gray level range of [0, L-1],level mapping is done by

$$\tilde{K} = (L-1) \times P_{wt}(k)$$

The weighted and threshold value of probability density function P(K) is obtained by the following equation given by,

$$P_{wt}(k) = \Omega(P(k)) = \begin{cases} P_u & \text{if } P(k) > P_u \\ \left(\frac{P(k) - P_l}{P_u - P_l}\right)^r \times P_u & \text{if } P_l \le P(k) \le P_u \\ 0 & \text{if } P(k) < P_l \end{cases}$$

Where Pmax is the peak value of the P(K) The real number v defines the upper threshold normalized to Pmax.The lower threshold Pl is on the other hand, is only used to cut off levels with too low probability to better utilize the full dynamic range. In our algorithm, we do not use Pl as a parameter and set it at a very low fixed value
After the weighting and threshold operation the remaining operation is similar to Histogram Equalization. The cumulative distribution function (CDF) of original frame is given by the equation

$$C_{wt}(k_n) = \sum_{m=0}^{k} P_{wt}(m)$$

For Kn = 0,1,…….,L-1
The resultant image G (i,j) let G(i,j) = F(i,j) is given by

$$\tilde{F}(i,j) = W_{out} \times C_{wt}(F(i,j)) + M_{adj}$$

The parameter Wout and Madj are invariant and it gives dynamic range of the output frame and return the mean change after enhancement. For a simple case, Wout is equal to the full range [0, L-1], and Madj=0. For video enhancement, we apply the proposed WTHE method on the luminance component and the chrominance components unchanged.

### *F. POST-PROCESSING:*

The final block of low light video enhancement system is post-processing .This is the final stage of enhancement at which the all abstracted frames of the video is rearrange properly according to sequence, and final noise removal is done by Gaussian filtering method that improve the video clarity and at the output we get provide enhanced video.At this stage the Gaussian filtering is done with the different values of parameters . Amount of filtering required is less than the previous stages because at this point the noise is very less than the previous stages so that the proper finishing

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of the video can be obtain by small amount of filtering and finally the enhanced video is obtain by concatenation of the frames.

## IV. EXPERIMENTAL RESULTS

We tested the proposed method with a real time video captured in an extremely low-light condition for this we used the different hardware systems for capturing experimental results.
Dell Inspiron N5050 Laptop - 2nd Generation Intel Core i3-2350M Processor 2.3GHz, 4GB DDR3 RAM, 500GB HDD, Windows 7,Webcam Camera 0.3MP Integrated Webcam with built-in analogue microphone,15.6" Display .
External webcamp used Intex IT-306WC Webcam Focus Range 4 to Infinity, Video and Image Video Sensor Resolution 30 megapixel Frame Rate 30 fps Still Image Sensor Resolution 30 mega pixel Is HD Sensor Type CMOS Image Capture Resolution 640 x 480 , the processing time we required for obtaining enhance video is 1.05sec per frame. we have showed the results of sample frames from real time low light video which are captured by different cameras. In Proposed method MATLAB is used as a software tool.

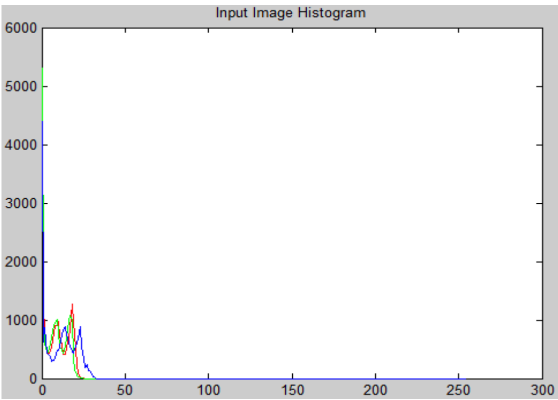
*a.Video Captured By System Webcam:* Figures 5a & 5f are low light video frames captured by using system webcam for different scenario and figures 5a & 5e are enhanced video frames obtained by applying the proposed enhancement method. figure 5c, 5d, 5g,5h shows histogram of different input and output frames respectively.

**-** For first scenario we get the input and output frames as shown in 5a & 5b.

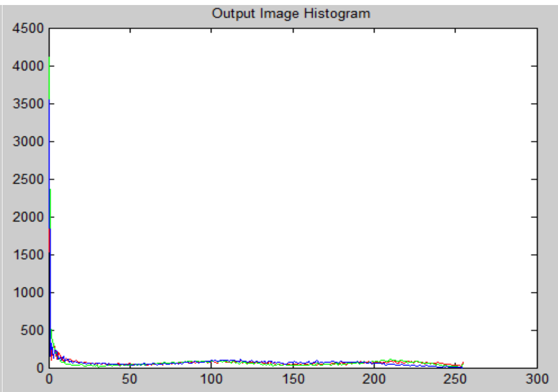
5a.

5b

**-** For first scenario we get the input and output frames histograms as shown in 5c & 5d.




5c.




5d

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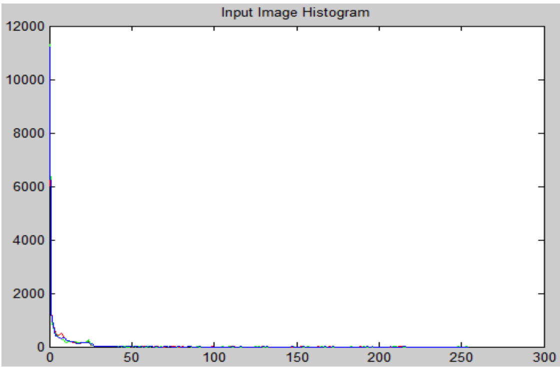
- For second scenario we get the input and output frames as shown in 5e & 5f.

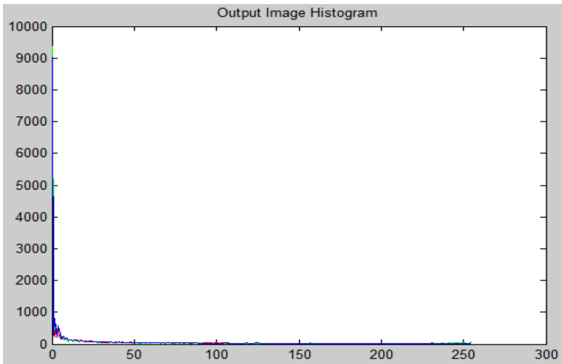
5e.

5f

- For second scenario we get the input and output frames histograms as shown in 5g & 5h.




5g.




5h

Figure 5.Illustration frames captured by using system's webcam: 5a) Input frame, 5b) output frame 5c)Histogram of Input frame5a , 5d): Histogram of Output frame 5b ,5e) Input frame, 5f) output frame, 5g)Histogram of Input frame5e , 5h): Histogram of Output frame 5f.

*b.Video Captured By External Webcam:* Figures 6a & 6e are low light video frames captured by using system webcam for different scenario and figures 6b & 6f are enhanced video frames obtained by applying the proposed enhancement method. figure 6c, 6d, 6g,6h shows histogram of different input and output frames respectively.

- For third scenario we get the input and output frames as shown in 6a & 6b

6a.

6b

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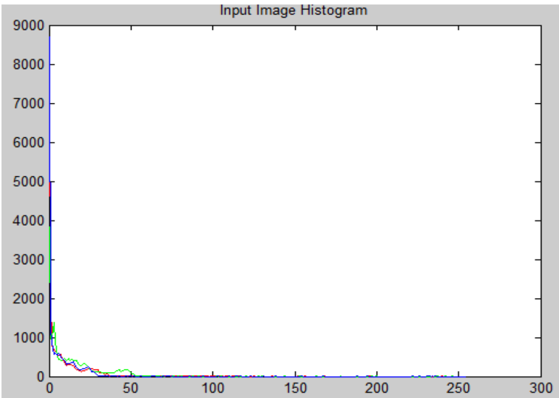
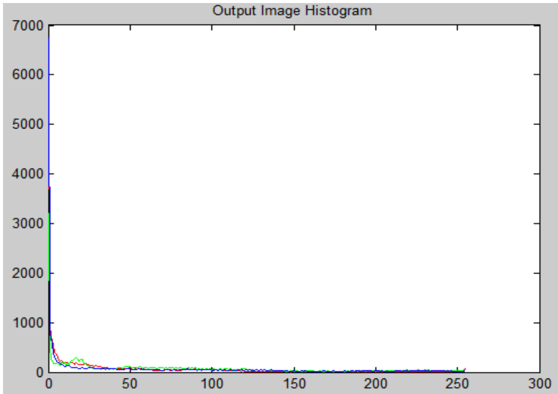
- For third scenario we get the input and output frames histograms as shown in 6c & 6d .



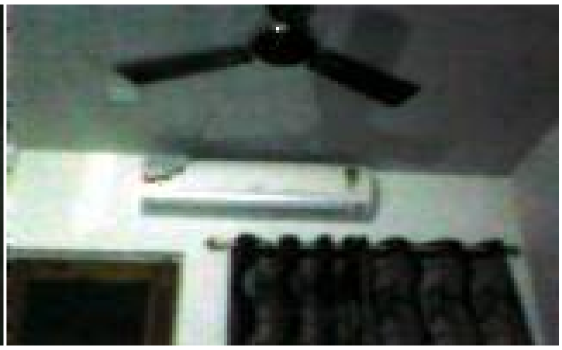

6c




6d.

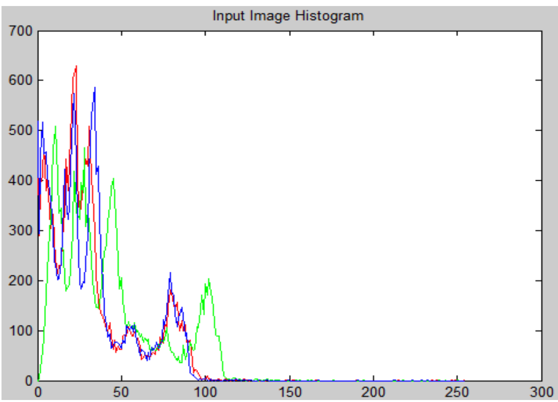
- For forth scenario we get the input and output frames as shown in 6e & 6f.

6e

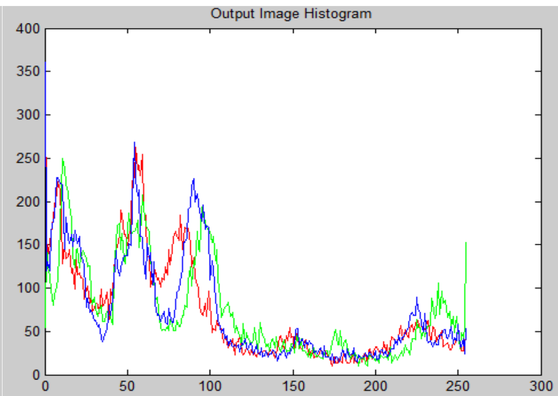


6f

- For forth scenario we get the input and output frames histograms as shown in 6g & 6h.




6g




6h

Figure 6.Illustration frames captured by using external webcam: 6a) Input frame, 6b) output frame 6c)Histogram of Input frame6a , 6d): Histogram of Output frame 6b ,5e) Input frame, 6f) output frame, 6g)Histogram of Input frame6e , 5h): Histogram of Output frame 6f

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## V. CONCLUSION AND FUTURE WORK

Video enhancement is one of the most crucial and difficult factor of video security surveillance system. The increasing use of night operations requires more details and integrated information from the enhanced video. However, low quality video of most surveillance cameras is not satisfied and difficult to understand because they lack surrounding area context due to poor illumination.As going through all scenario of video enhancement and need of it in our day today day life we are decided to work on this problem so that our efforts are able to provide better solution . Therefore in this method we are basically improved the quality of the captured low light video by applying the different operations or algorithms such as Gaussian smoothing for smoothing of video then we used adaptive median filtering for removal of noise then as the input video is low light the contrast enhancement is applied to the video for this we use WTHE method and finally again the remaining noise removed by the post **-**processing and enhanced video is obtained.The present study is confined to the removal of noise and provide more visible video, but in future new algorithm can be developed to enhance video in extremely low light condition or haze condition. We leave this for future work so that a more efficient algorithm can be developed for low light video enhancement.

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