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UNSUPERVISED FACE DETECTION IN DARK AND LOW LIGHT

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Abstract : Darkness is the opposite state of brightness, resulting from the absence of perceived light and light. In general, facial recognition applications cannot detect a person's face in a dark image where the image is taken in a dark environment or at night. In this manuscript, we present our experiments using contrast stretching, histogram smoothing, and adaptive equalization techniques to detect human faces in any dark image. This paper also illustrates our proposed algorithm, operation procedure and pixel intensity extraction from different stages of image processing. We do this research mainly from the perspective of applications where the software detects a human face from a dark photo or image with very low contrast and the image is taken from an environment that is too dark. .

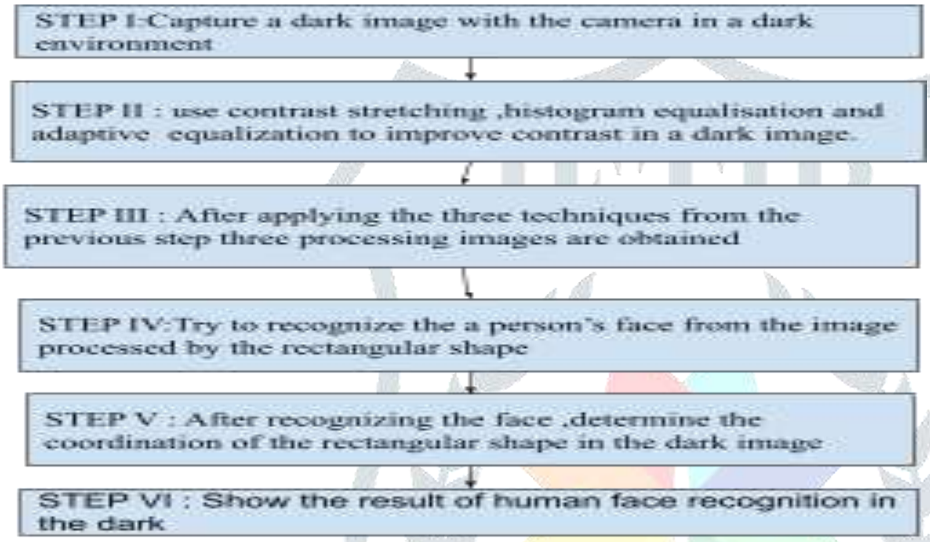
INTRODUCTION

Human face detection and recognition are currently important topics in image processing and computer vision. More often than not, if a photo comes from a very dark environment, most software cannot detect a person's face. Here, higher medium means that condition where we have very little light and the photo of this condition is very low intensity. The problem occurs when shooting at night without a flash or light. In this situation, software programs cannot recognize a human face from a dark image [1], [2]. In addition, in recent years, research papers have been published in which researchers have shown how to recognize or recognize human faces in the dark night using the concepts of "Night Vision", "Thermography" and "Infrared Vision" [3]— [6]. Using these three methods is really expensive and requires a specific device and camera. Furthermore, these manuscripts do not show how to identify a human face from a dark image without these three methods. In addition, three more recent attempts to detect partial imperceptible objects in dark and foggy images are disclosed. Two discussions were presented [7], [8]. Another method that solves a similar problem, but this method was used to identify organs in the human body [9]. Furthermore, these previous studies did not demonstrate any approach to human face recognition from a very low-contrast dark image. According to this research gap, an approach for human face recognition from dark image is proposed. In developing our test, we used contrast stretching, histogram equalization and adaptive equalization methods. For us, the detection and recognition of human faces are currently important topics in the field of image processing and computer vision. More often than not, if a photo comes from a very dark environment, most software cannot detect a person's face. Here, higher medium means that condition where we have very little light and the photo of this condition is very low intensity. The problem occurs when shooting at night without a flash or light. In this situation, software programs cannot recognize a human face from a dark image [1], [2]. In addition, in recent years, research papers have been published in which researchers have shown how to recognize or recognize human faces in the dark night using the concepts of "Night Vision", "Thermography" and "Infrared Vision" [3]— [6]. Using these three methods is really expensive and requires a specific device and camera. Furthermore, these manuscripts do not show how to identify a human face from a dark image without these three methods. In addition, three more recent attempts to detect partial imperceptible objects in dark and foggy images are disclosed. Two discussions were presented [7], [8]. Another method that solves a similar problem, but this method was used to identify organs in the human body [9].

Furthermore, these previous studies did not demonstrate any approach to human face recognition from a very low-contrast dark image. According to this research gap, an approach for human face detection from dark image is proposed. In developing our test, we used contrast stretching, histogram equalization and adaptive equalization methods. We have

2. Proposed model and Process

Our research revealed an application-based model that demonstrated how a computer program can recognize a human face from a dark photograph. At first, a photo was taken of a dark environment or night, and we measured the intensity of the pixels. This image was then subjected to contrast stretching, histogram smoothing and adaptive smoothing. Contrast stretching is also called image normalization, which improves a dark image by expanding the range of image intensity values [10]–[12]. Histogram equalization adjusts image intensity to improve contrast [13]. In the field of image processing, Adaptive Equalization was also known as Adaptive Histogram Equalization (AHE), which is used to improve the contrast of images by changing the intensity [14]. Using these three techniques or methods, the dark image was enhanced with a special contrast and the pixel intensity was again measured. When a face is detected by any of the technologies, an updated image is displayed where we traced the person's face on a rectangular dark image. In Figure 1 , we illustrated the algorithmic flow diagram of our experiment and in Figure 1 . 2 we have shown our experimental visualization.



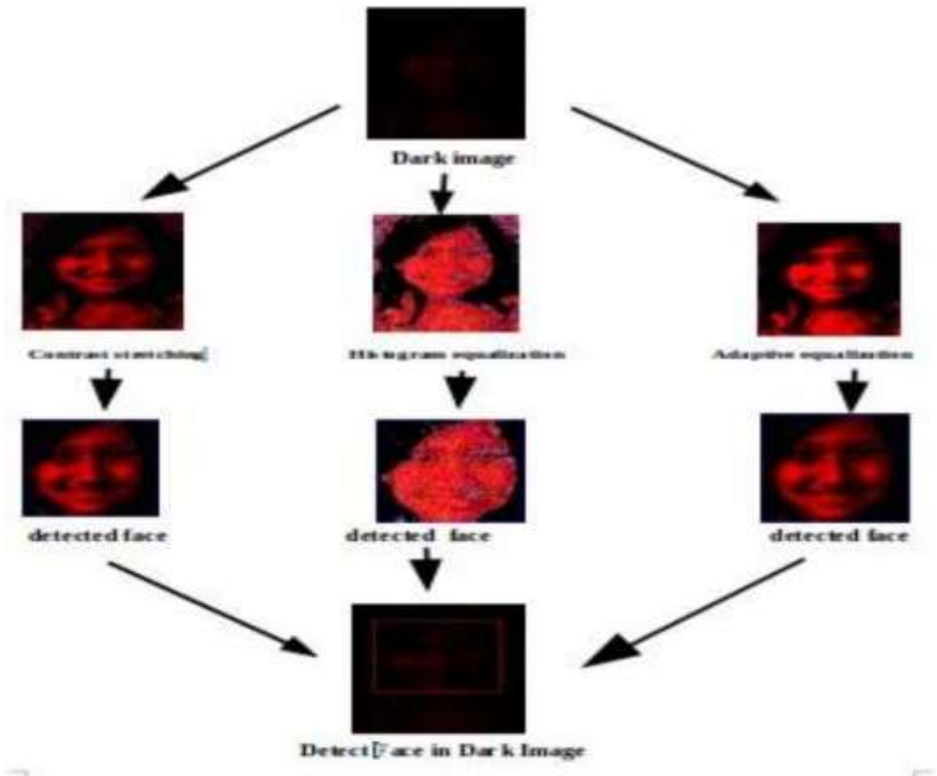


Figure 2: Image processing and visualzation of our experiment.

3. Dark image processing

Our research revealed an application-based model that demonstrated how a computer program can recognize a human face from a dark photograph. At first, a photo was taken of a dark environment or night, and we measured the intensity of the pixels. This image was then subjected to contrast stretching, histogram smoothing and adaptive smoothing. Contrast stretching is also called image normalization. There are a number of techniques to improve the contrast of a dark image. The study was described as dynamic stochastic resonance, which improves the contrast of dark and low contrast images [15-16]. Noise-induced technology requires updated adaptive image processing and significantly increases contrast and colors [17]. A content algorithm improves a dark photo, sharpens the edges of a textured area, and preserves the smoothness of a smooth area [18]. Autofocus uses a robust focus on a low-contrast image, where the approach is based on energy [19]. On the other hand, the driving waveform works very effectively to reduce dark image capture [20]. In our experiment, we used contrast stretching, histogram and adaptive equalization to increase the contrast and pixel intensity of a dark image.

3.1. Contrast stretching or Image normalization

Contrast stretching is an operation applied to images that increases the contrast of the image so that the image appears clean. Contrast stretching is sometimes called image normalization. Our experiment used contrast stress formula [21] which is given below: – * (1) – () o o i o o o i o Max Min I I Min Min Max Min Here Io is pixel output, Ii is pixel input, Mini is the smallest pixel of the input. image, Maxi is the maximum pixel of the input image, Min is the minimum pixel of the output image, and Maxo is the maximum pixel of the output image. Here, the input is a dark image and the output is a contrast stretching method image. This is shown in Figure 2. After using this formula, we got a new image where the pixel intensity is higher than the pixel intensity of the dark image.

3.2. Histogram equalization

In general, a histogram is an estimate of the probability of some type of data. An image histogram is a type of histogram that graphically represents the general pattern of gray values in an image. In general, histogram smoothing is a method of adjusting or synthesizing the intensity of an image to increase contrast. The histogram smoothing procedure is based on the use of the cumulative probability function (c d f). Consider the image represented as f.
Pixel intensities range from 0 to L to 1. L is the likely intensity values . Normalized histogram marked p. From the initial steps of histogram equalization [22], we get the Pi rof pix xels intensity integer els (2) np n Where n = 0, 1, ..., L − 1. The last step of histogram equalization is as follows : 1 1 ( ) (T (T ( )) ( )) (3) Y X d py p y dy Here the image intensities contain random values X, Y. pX is the potential f-density function. T refers to the cumulative distribution function of X. In histogram smoothing, T is differentiable and invertible. Y is defined by the formula T(X), where T is distributed over [0, L − 1]. Using the histogram smoothing method, we get the update shown in Figure 2

3.3. Adaptive Equalization

Adaptive Histogram Equalization (AHE) is also known as adaptive equalization. It differs from traditional histogram smoothing in that the adaptive technique computes different histograms. This method applies to one part of the photo and takes them around to redistribute the brightness of the image. This is a suitable process to enhance local contrast and enhance the edges of each image. Where (x, y) is the pixel-mapped location and i is the image intensity.
Description m ,− in grid pixel (x , y−) top right x ,−. Therefore, the description at the bottom right x m , . Description of the lower left x− m−. Description of the lower left x−,− m−,−. So the formula of the adaptive equation m(i)=a[bm−,−(i) (1−b)m ,− (i)] [1−a] [bm−, (i) (1−b) m , (i)] (4) Where, ; y y x x a b y y x x Using the adaptive equalization equations given in equation 4 [23], [24], an updated image is obtained, which is illustrated in the figure. 2.

4. Proposed algorithm

In this section, we presented the idea of programming and the structure of our algorithm. The algorithm was implemented in the Python programming language and also used the Open Source Computer Vision Library (OpenCV) [25], [26]. The idea of the algorithm (see Algorithm 1) from a programming perspective is as follows: The idea of the algorithm (see Algorithm 1) from a programming perspective is as follows: First read a dark image and set this image to dark Image. An array testImg[ ] containing testImg1, testImg2, and testImg3 is declared to detect contrast stretching, histogram, and adaptive equalization images. Using these three techniques, three new images are placed in folders testImg1, testImg2, testImg3 respectively. The second table detectFace[ ] declared to be collected detected face image containing detectface1, detectface2, detectface3. Array detectionImg[ ] will display the face detection result as a dark image. detectImg[ ] contains variables face detectImg1, detectImg2, detectImg3. Haar Cascade feature [27] is used to detect human foreground. Then set it to face_cascade. Some rectangular points (x, y, w and h) are provided to color or label the dark image face detection. A variable i which is initially zero but is incremented by the value of i in each loop part (i) until testImg[ ].length( ) is not complete. A temporary readImg variable containing the given testImg[]. Then load the test image (readImg) in grayscale and use the "RGB ↔ GRAY" flag [28] with the OpenCV library function cvtColor( ) [29]. This function was used to convert one color space to another. The function detectMultiScale( ) [30] is used to detect faces in a grayscale image using the Haar cascade classifier [31]. There the "inner for loop" works to detect faces from testImg[] images (testImg1, testImg2 and testImg3). The Python OpenCV library has a rectangle ( ) function [32] that draws a rectangle on a dark image (img) and detects the image (testImg1, testImg2, testImg3). The concept of region of interest (ROI) was created to implement facial recognition [33] in readImg.

With the imwrite( ) function, detect a face in readImg, detect a face in a dark image (darkImg) and save these images in a directory. Finally show the result of specific detection image with face detection in dark image.

Based on the above discussion, the target algorithm from the programming perspective [34], [35] is formed according to Algorithm 1:

Algorithm :

Dark Image Face Recognition Algorithm.
1: import OpenCV library cv2;
2: darkImg read raw dark image;
3: testImg[testImg1 , testImg2 , testImg3];
4: testImg1 ContrastStretching(darkImg);
5: testImg2 HistogramEqualization(darkImg);
6: testImg3 AdaptiveEqualization(darkImg);
7: detectFace[detectFace1, detectFace2, detectFace3];
8: detectImg[detectImg1 , detectImg2 , detectImg3];
9: face_cascade Detect face using Haar Cascade Classifier XML file;
10: rectangular area Pont: x; y; w; B;
11: i = 0;
12: while (testImg[ ].length( ) is not complete)
13: readImg testImg[i];
14: gray cv2.cvtColor(readImg, RGB ↔ GRAY flag); 15: face face_cascade.detectMultiScale(gray,1.1, 5);
16: for (fill x,y,w,h face)
17: cv2.rectangle(rowImg,(x,y), (x w, y h) ,(255,0,0), 2) ; 18: cv2.rectangle(darkImg,(x,y), (x w,y h), (255,0,0), 2);
19: ROI_gray gray[y : y k, x : x w];
20: ROI_color readImg[y : y h, x : x w];
21: cv2.imwrite(detectFace[i], ROI_color);
22: cv2.imwrite(detectImg[i], darkImg);
23: showResult(detectImg[i]);
24: Finally
25: i;
26: Stop a moment

5. Result and Analysis

The proposed technique was developed in Spyder IDE and Anaconda [36]. We measured the average intensity of a different image. Figure 3 shows the face detection rate on a dark image using contrast stretching, histogram smoothing and adaptive smoothing methods. After applying these three techniques, we found that contrast stretching showed better performance in dark image face detection. Here, contrast stretching 90%, histogram smoothing 83%, adaptive histogram smoothing 84% are detected on dark images. Some images are rendered with only one or two processes.

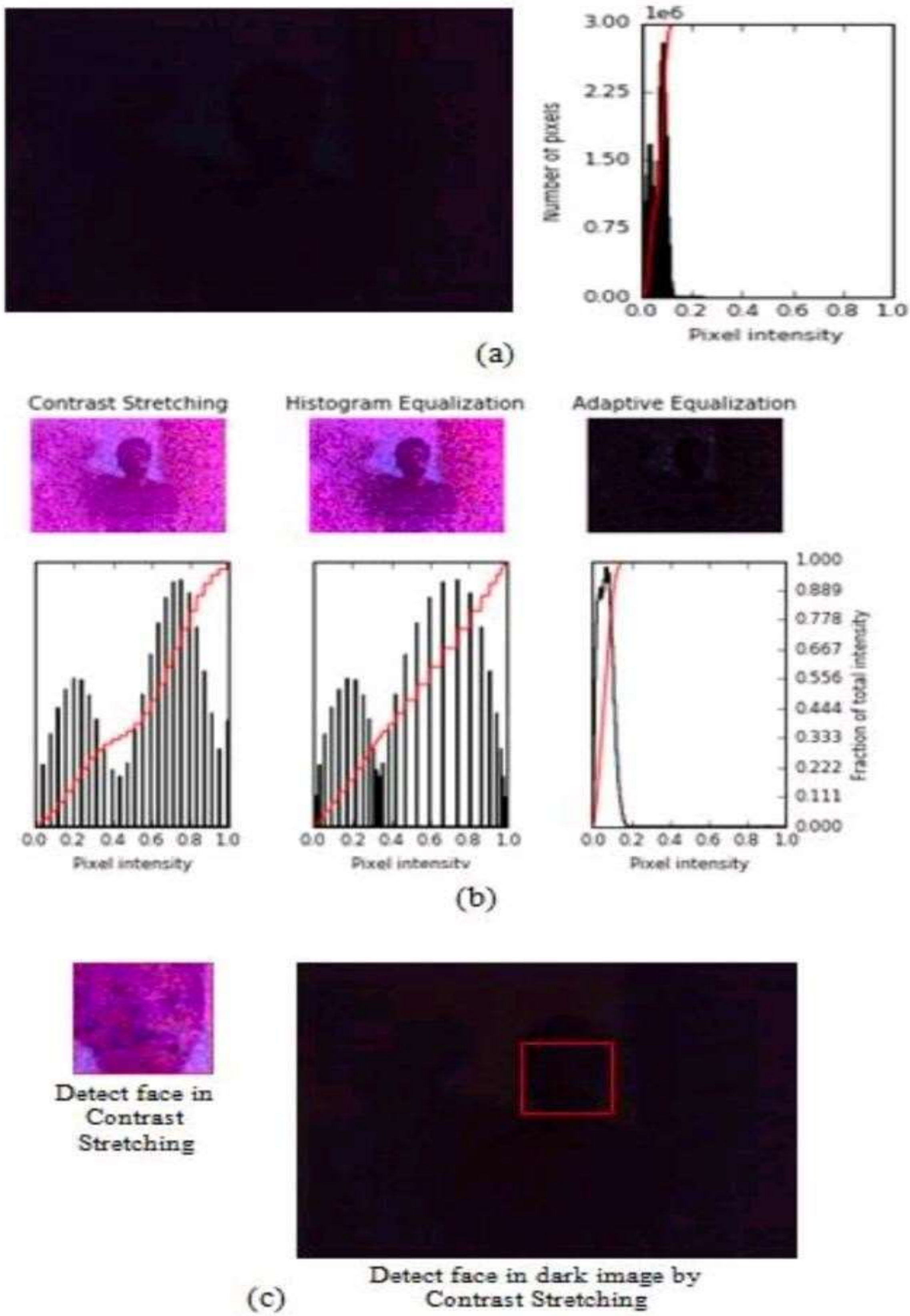


Fig. 4: Experiment Results of Face Detection in Dark Image.

Figure 5, section (a) shows a dark image with its pixel count and intensity, where the pixel intensity of the dark image is obsessively low. Part (b) shows the different results of the three techniques. In contrast, with stretching and histogram equalization, pixel intensity is increased, but with adaptive equalization, pixel intensity cannot be increased. Therefore here, using contrast stretching and histogram smoothing, a face can be detected in the dark image shown in (c). In this case, adaptive equalization techniques cannot detect faces because the pixel intensity cannot be increased in this process.

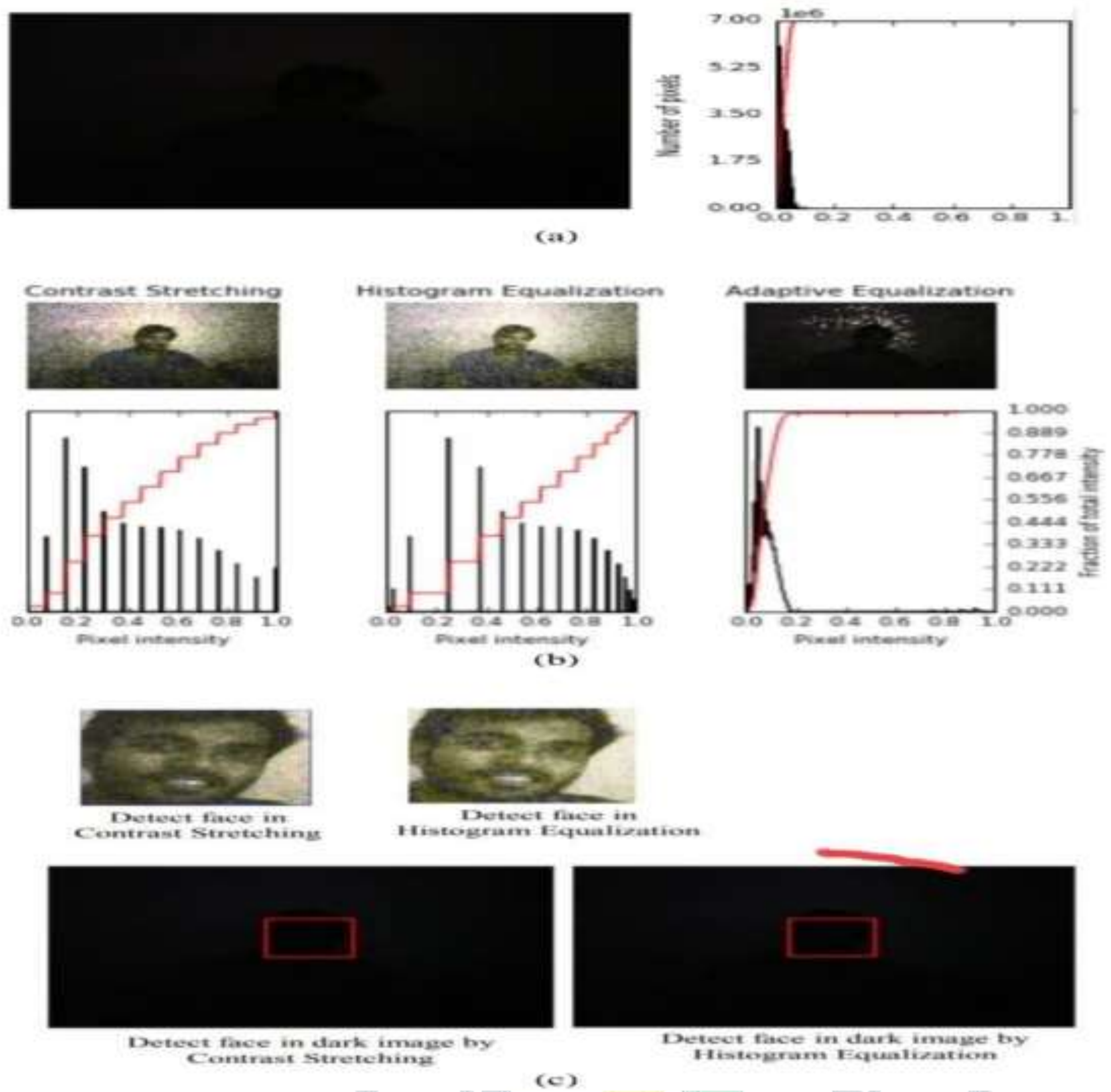
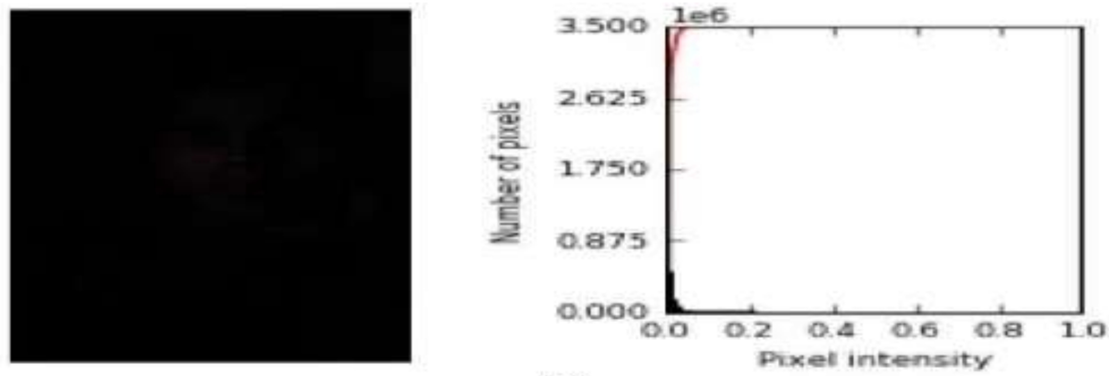
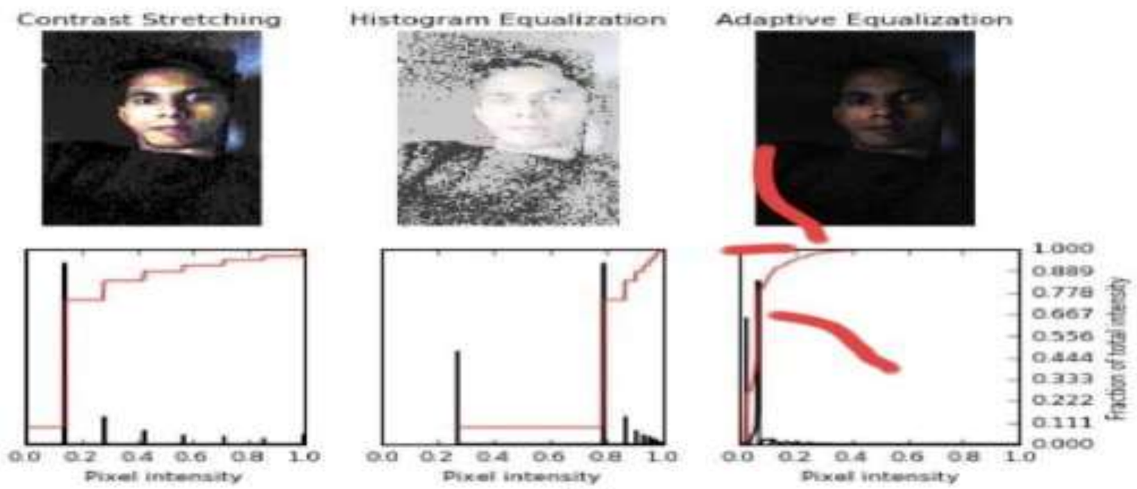


Figure 5: The result of the second experiment on face recognition in a dark image

Figure 6, section (a) shows a dark image with low contrast and its pixels are intensively read. Part (b) shows three different images using contrast stretching, histogram smoothing and adaptive smoothing and their plots. In contrast to stretching and histogram smoothing, the pixel intensity is improved, but with adaptive equalization, the pixel intensity is also increased, but not too much. In this case, all technologies recognize the face. Then assign the orthogonal coordinate of the detected face images to the dark images shown in (c). Regarding dark image detection, we can see that the image shows a rectangular shape. This rectangular shape detected a face in a dark image. After processing our proposed Algorithm 1, the program had four points in the images of the methods of contrast stretching, histogram equalization and adaptive equalization. Then coordinate the shape of the rectangle in the dark image.



(a)



(b)

6. Future works and Conclusion

An experimental study illustrates an approach to face detection in a dark image by showing how a computer application can detect any human face from a dark image using contrast stretching, histogram smoothing, and adaptive equalization techniques. The program is currently being developed in terms of artificial intelligence (AI) and machine learning. These are the main researches for our future exercises to better approach face detection in dark images. The whole concept of dark environments can be turned into a scientific model with different learning computations (Deep Learning and Neural Networks). With our fourth upcoming search, we hope to complete real-time facial recognition in the dark using machine learning and our own implemented software based on Computer Vision.

Acknowledgement

The research experiment was organized by the Department of Software Engineering (SWE) and the Department of Multimedia and Creative Technology (MCT) at Daffodil International University. This research is guided by the thesis [37]. We developed our proposed model and application in the laboratory of Smart Data Science Center (SDSC) [38]. SDSC is the computer research and innovation laboratory of Daffodil International University.identsed. It is primarily intended for computer programming novices to lay the foundation for Android application (OS) development. It has a graphical client interface similar to Scratch., MIT App Inventor and its variations. An application is created simply by moving some components and connecting some boards, just like in Scratch. It runs on Google App Engine and uses some of Google's cloud services. There is a design panel with maps that show the nuances of each application. The maker has two pages: Designer and Blocks. At the top of the designer are drop-down menus and four main areas: Palette, Mockup, Components and Properties. The Palette section contains a list of all the appropriate parts that are striking for designing apps on the phone. The entire content of the component board can be read as a summary of this home page, and customers can customize the aesthetic properties of these components in the Attributes section. On the Blocks page, there is a Blockly card with which a program is programmed by connecting squares.

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