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# Detectionand Removal of Flash Eye in Digital Images and Its Hardware Implementation

KEYWORDS

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**ABSTRACT** *Red eye and flash eye defects in still photography continue to cause a problem in digital images. Red eye effect appears when flash photography is used at night because the eye is unprepared for the sudden influx of light. Many techniques have been proposed for the removal of this effect but most of them are semi automatic and are not fully efficient. This papers deals with the same problem. Latest technique which is the support vector machine(SVM) technique is used for the red eye detection and correction followed by its hardware implementation. It is a fully automatic technique which means that we do not have to manually locate the red eye area.*

**1)Introduction**

In flash photography the light of the flash occurs too fast for the pupil to close so much of the very bright light from the flash passes into the eye through the pupil, reflects off the fundus at the back of the eyeball and out through the pupil. The camera records this reflected light. The main cause of the red color is the ample amount of blood in the choroid which nourishes the back of the eye and is located behind the retina.

Support vector Machine(SVM) technique is a fully automatic technique for red eye removal. In this method firstly the SVM classifier is trained. the skin region is detected by using the pixel based support vector technique. If any extra non skin area is left then morphological operation is carried out for removal. Many new features like geometric and color metrics are also proposed for better classification of the image. Finally support vector machine is used to classify the output of skin detected images by the use of presented features.

Firstly, the skin region is detected by using the pixel based support vector technique. If any extra non skin area is left then morphological operation is carried out for removal. Many new features like geometric and color metrics are also proposed for better classification of the image. Finally support vector machine is used to classify the output of skin detected images by the use of presented features.

**Figure 1 An example of red eye effect in image**

**2)Literature Survey**

In 2001 hardeberg [1][2], presented a semi-automatic method in which the red-eye region had to be selected manually. Later he also proposed a fully automatic technique based on preliminary color segmentation based on thresholding[3]. In 2003Loffe et al[4] presented a learning based method which combined both face and pupil detector for localizing red eye regions. In the same year Smoka et al[5] proposed a threshold based technique in which skin like region is detected first followed by red eye detection. Lea et al [6] in 2004 used Adaboost method to detect the red eye region. Yoo et al [7] used biometric method information for correcting red eyes. Wang et al [8] in 2006 used morphological filters and several heuristic exclusive principles to detect the red-eye region and corrected it by adaptive correction technique. The main cause or the red-eye effect is the flash light which picks red color from the blood in the retina. To reduce this effect, many advancements have been made in the cameras. Pre-flashes have been used in cameras before the picture is captured which contracts the pupil, thus minimizing the area of reflection. But there are some drawbacks of this. Firstly it will not completely remove the red-eye effect. Secondly this technique is more power consuming. In 2004 ,Lue et al [9] proposed a two module approach include: red eye detection and its correction.Marchesotti[10] focused mainly on red eye detection than the correction part as it was more tedious task. He proposed three correction methods and made a comparison between them. In the field of correction, Dobbs and Goodwin were the first to propose the recoloring of the selected image in handheld devices.

**2)SVM Technique**

Support vector machine is a classifier that efficiently trains a linear learning machine. It is based on the concept of decision planes that define decision boundaries. Decision plane is one that separates between a set of objects that have different classes. The classifier does smart work. By saying this we mean that the algorithm is trained many times so that maximum accuracy is obtained when it is used in practical applications.

Figure shows the block diagram of a fully automatic red eye reduction technique.

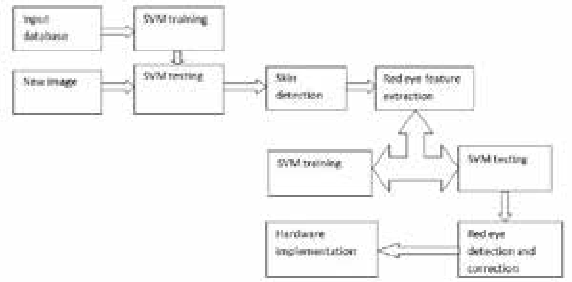


**Figure 2 red eye removal technique using SVM**

SVM classifier can be used in many other applications also other than red eye detection. Classification of images can b performed using SVM. SVM can be used in medical sciences for the classification of proteins etc. Hand written characters can b recognized using SVM. SVM classifier can be used in security applications also.

The decision function is classified as follows

$$y = \operatorname{sgn}\left(\sum_{i=1}^{N} y_i \alpha_i K(x, x_i) + b\right) \quad (1)$$

**3.1) Face detection**

Our first motive is to detect the face area. In a single picture, there may b more than 1 faces. Hence the detection of face is one of the most tedious task .color is the main key tool used for the detection of face. The skin has different color shades. SVM classifier has been proven as the best classifier which can detect all the color shades easily. The images are in RGB form. First the image is changed from RGB(red green blue) color mode to HSI(hue saturation intensity) color mode. This is done due to the reason that HSI color mode is high intensity invariant. Hence its better suitable for the classification of image. Each pixel is classified independently. Each pixel has its 3 components(hue saturation intensity). Hence the structure of the classifier is of the order of 3*n. the output is either 0 or 1. Morphological operation is carried out in case any non skin area is added. All the work is performed in matlab environment .

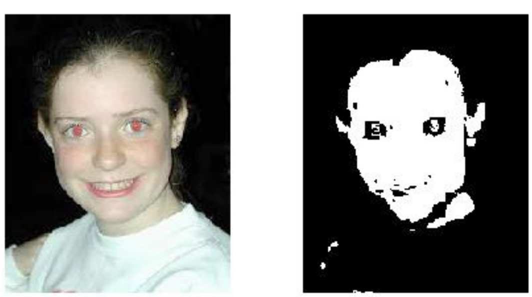

**Figure 3(a) input image**
**Figure3(b) Output image after skin detection**

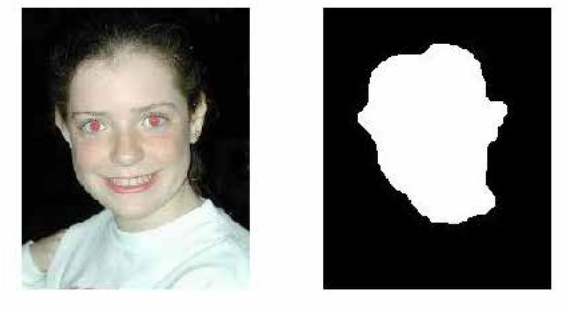

**figure 4(a) input image**
**figure4(b) output image after SVM classification and morphological operation**

**3.2) Red-eye Localization**

After the detection of face our next step is red eye detection. The red eye detector used different skin features for the detection of red eye. They are divided into two main classes

1) Color metrix- color plays the most important role in the detection of the red part .

The color metric deals with the change in red color in the face area. It records the change in luminance conditions and redness of the skin parts.

2) Geometric constraints: There may exist some areas in which has same color as the red eye but not the part of it, hence they have to be removed. This can bring about serious difficulty in locating the red eye accurately. In order to overcome these false hits, geometric constraints are carries out. Morphological operation is carried out again to improve the performance.

Our face has many red parts like lips , any red spot on face etc. Sometimes the algorithm wrongly detects the other face parts as red eye. Haar like feature are used for the red eye detection along with Adaboost classifier. In this main focus is done on the upper part of the face. That is the eye part and the SVM results are checked in that part. These results are then concluded as final results. This gives maximum accuracy results.

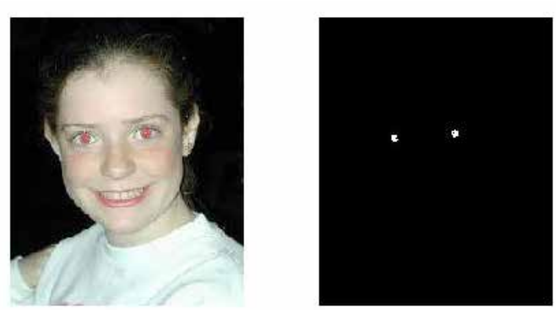

**Figure 5(a)original image**
**Figure5(b) red eye located image**

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**3.3) Red eye removal**
After red-eye localization our last step is red eye removal. Red color is removed by just adjusting the color values. This is done by simply removing the red area and making it dark by applying some equations on that area.

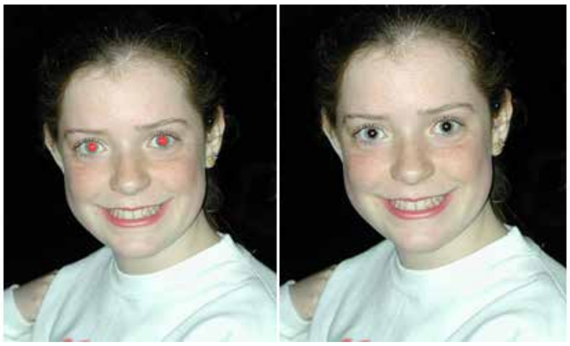

**Figure 6(a) original image**
**Figure6(b) corrected image**

Following are a few other images before and after red eye correction.

**Figure 7(a)original image**
**Figure 7(b) corrected image**

Hence the red eye is corrected with 90% accuracy.

**4) Hardware implementation of SVM technique for skin detection.**
Implementing SVM classifiers on suitable computing devices like FPGAs can exploit the potential of custom precision algorithms. The hardware implementation of SVM classifier is done by co simulation on mat lab and QuestaSim. Each pixel is classified independently. Each pixel further has 3

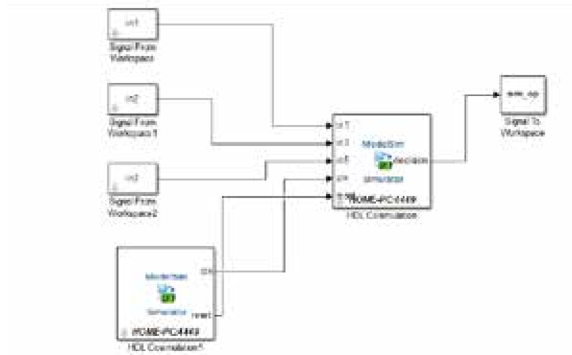

**Figure 9 co simulation model**

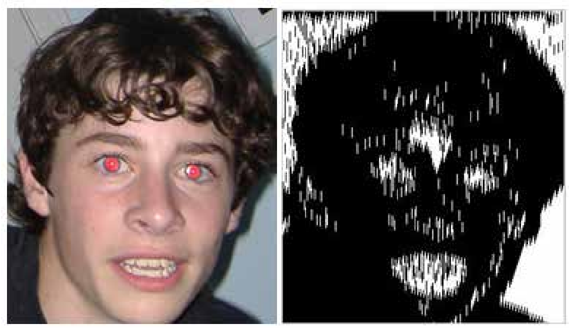

**Figure 10(a) original image**
**Figure 10(b) Image after skin detection**

Here are the synthesis results which are studies in Xilinx

1) Total power consumption =0.582W
2) Dynamic power consumption= 0.083W

Hence the skin area is detected and its hardware implementation is completed.

**5) Conclusion**
In this paper skin detection and then red eye detection is carried out by using SVM technique and then its correction part is done using Mat-Lab environment. After this hardware implementation is carried out using co simulation of mat lab and QuestaSim. Synthesis results are observed using Xilinx tool. The results of red eye correction are compared with the previous papers. Hence the red eye detection and correction is carried out along with hardware implementation.

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