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DWT improved Statistical Model for Eye Blink Detection in Video

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Abstract: The presented work will be defined in four main stages. In first stage, the video frames will extraction and conversion to the image forms will be performed. In this stage, the identification of unique frame sequence will be done to reduce the processing frameset. In second stage, the frame processing and segmentation will be performed to identify the face area over the frame. In third stage, the positional and radial method will be implemented to perform the eye localization. In fourth stage, the eye blink will be identified in the continuous frames. The presented work is a hybrid model that will include the effective approach at each stage. To identify the frame similarity, the DWT based similarity measure will be performed. To perform the facial area recognition, the morphological operators along with color model will be implemented. To identify the iris location a statistical hybrid approach using positional and radial analysis will be performed. In fourth stage, the distance oriented matching will be performed to recognize the eye blink.

Keywords: Image segmentation,video segmentation ,eye blink detection

I. INTRODUCTION

Today the biometric recognition systems are not only used for the authentication process but there are number of other such applications such as hand sign recognition, human activity recognition, computer to human interaction. Eye blink recognition is one of such research area having number of related application. These applications includes the identification of fatigue in human, drunken person identification, monitoring the activity of comma patients, emotion recognition etc. The presented work is in same area to identify the fatigue or the drunken person by analyzing the eye blink frequency. The presented work will be implemented on videos to monitor the person eye blink acidity. In the past, several background segmentation techniques have been used to identify the objects of interest in a scene. The term "background segmentation" refers to identifying the difference between an image and its background using any of the techniques mentioned in [4] and then thresholding the results to identify an object of interest[3]. The paper discussed here are related to the activity recognition and classification using different approaches such as neural network, DWT etc.

II. SEGMENTATION TECHNIQUES

Two techniques - frame differencing and Gaussian mixture are used generally for background segmentation. Both of them have their respective advantages and shortcomings in an environment that involves a constant moving background.

2.1.1Frame Differencing:

This is one of the most common techniques used in background segmentation. As the name itself suggests, frame differencing involves taking the difference between two frames and using this difference to detect the object. The approach we use is very similar to this and is a two part process. First, the object is detected using frame differencing. Then this detected object is compared with the ground truth to learn the reliability of this approach.

Two consecutive frames are loaded from a given sequence of video frames. These color frames are converted to gray scale intensity. Otsu's Method [1] is then used to determine the threshold value of the gray scale images. The threshold value is obtained such that the pixel values on either side of this value are established to be either a background or a foreground pixel.

Following Otsu's method[1], the two consecutive gray scaled images are differentiated and their absolute difference is used to identify the movement between frames. The noise collected due to differencing is removed by applying the threshold value to the images. The threshold value that we find in our case varies between [0.43 - 0.45]. Pixels below the threshold are removed from the differenced frame leaving behind our object of interest. As described in equation 1, the absolute difference between two frames needs to be greater than the threshold for the object to be detected.

$$| f_1 – f_2 | = T \quad (1)$$

Here *f1* is the initial frame, f2is the following frame and *T*is the threshold value.

2.1.2 Gaussian Mixture:

This is another technique that is commonly used for performing background segmentation. In their paper [5], Stauffer and Grimson suggest a probabilistic approach using a mixture of Gaussians for identifying the background and foreground objects. The probability of observing a given pixel value *tp* at time *t* is given by [5]:

$$P(X_t) = \sum_{i=1}^{K} w_{i,t} * \eta(X_t, \mu_{i,t}, \Sigma_{i,t})$$

where *K* is the number of Gaussian mixtures that are used. The number of *K* varies depending on the memory allocated for simulations. The normalized Gaussian η is a function of ti,ω, ti,μ, ti,Σ which represent the weight, mean, and the covariance matrix of the ith Gaussian at time *t* respectively. The weight indicates the influence of the ith Gaussian at time *t*. In our case we choose $K = 5$, to maximize the distinction amongst pixel values. Since this is an iterative process, all the parameters are updated with the inclusion of every new pixel. Before the update takes place, the new pixel is compared to see if it matches any of the *K* existing Gaussians. In this way the Gaussian segmentation method follows a complex procedure.

Frame differencing is a very primitive technique that could be implemented very easily. In comparison Gaussian Mixture approach requires several resources for it to be effective. Hence, frame differencing is preferred and used for the analysis performed in this study. This will help us identify an approach that would be most suitable to a given system's unique requirements.

III. OBJECT SEGMENTATION

In object segmentation , video is taken as input which is converted into image format[2] .After conversion, the image format is converted into lowest common denominator grayscale file format i.e PGM format. The name "PGM" is an acronym derived from "Portable Gray Map."This PGM format is converted into hexadecimal format. Noise is removed from the image frames by implementation. Object segmentation is formed by separating foreground and background objects.

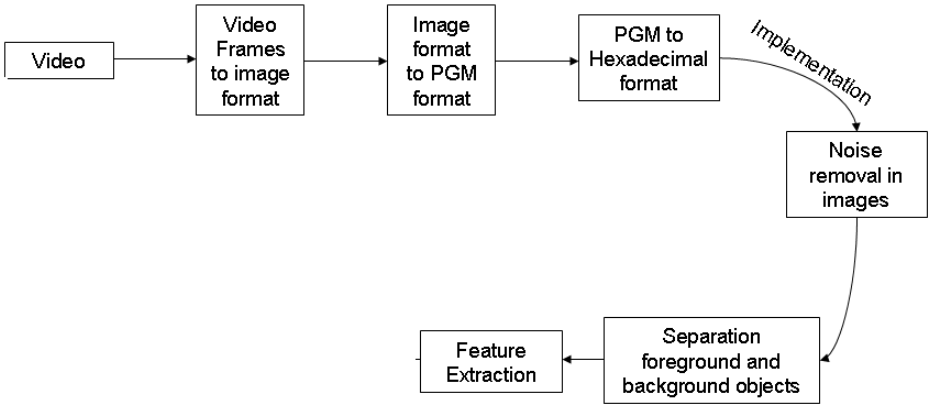

Figure 1 : Feature extraction over video

Our approach:

Eye blink detection model

The presented work is about to identify the eye blink detection over the videos. This work is presented as a four stage model as shown in figure.

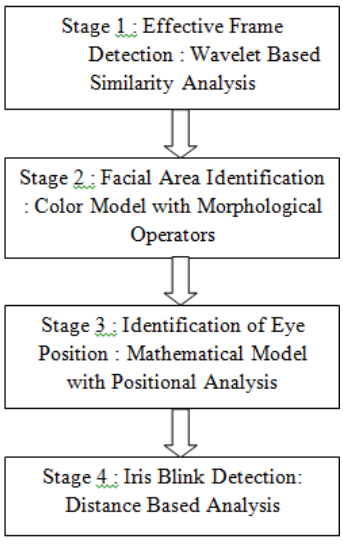

Figure 2: four stage process to detect eye blink over videos

The model will begin by accepting the video file as input data to the application. This video file will be first analyzed frame by frame to identify the effective frame sequence so that the processing dataset will be reduced. This effective frame identification will be done using wavelet based analysis. Once the effective frame sequence will be identified, each frame of this sequence will be processed to locate the facial area over the frame image. To perform the facial identification, the skin segmentation will be performed using the morphological operators and the color model. After locating the face area, in third stage, the mathematical model will be applied to identify the eye area. The mathematical model will be the composition of radial method along with positional analysis. At the final stage, the distance based analysis will be performed to identify the eye blink over the image. This stage will also count the frequency of eye blinks over all frames. The main methodologies used in this work are given

1)image segmentation

2)video segmentation

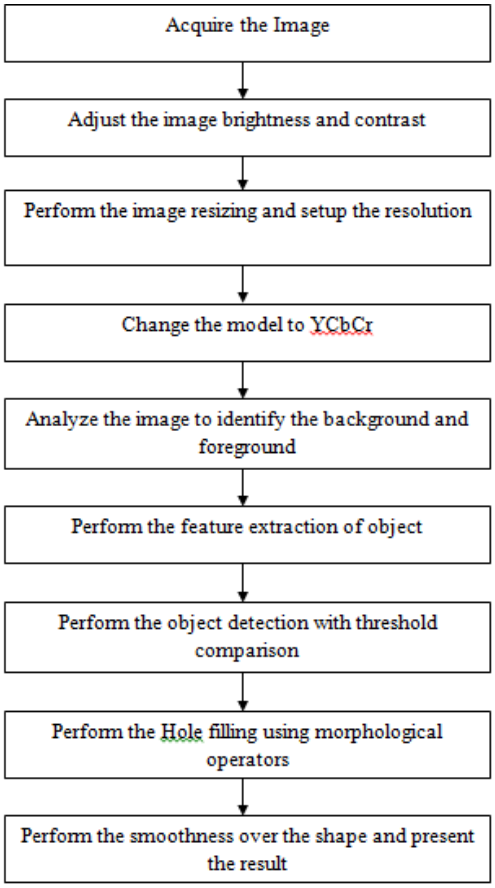

Figure 3:- Image segmentation stages

In image processing, segmentation falls in to the category of extracting different image attributes of an original image. Segmentation subdivides an image into constituent regions or objects. The level to which that subdivision carried out is a problem specific. The simplest method among all segmentation methods is threshold-based method, whose volume uses either a manually or automated generated threshold values for segmentation. In this method first the histogram of the image is computed then a particular value of threshold (intensity) is selected to segment the region. However in this method the intensity values often suffer from non-uniformly distributed contrast values inside the vessels. So, global threshold based methods and vessel segmentation are not useful in case of structure."Image segmentation is the process of partitioning an image into meaningful regions with respect to a particular application.""Image Segmentation is the process of dividing a digital image into segments ."Segmentation is to subdivide an image into its component regions or objects. It should stop when the objects of interest in an application have been isolated [1]."

Segmentation algorithms are based on one out of two basis properties of intensity values

- Discontinuity: To partition an image based on sharp changes in intensity (such as edges).
- Similarity : To partition an image into regions those are similar according to a set of predefined criteria.

IV. VIDEO SEGMENTATION

Video segmentation is similar to image segmentation despite of images here video frames. when video frames are extracted similarity measures are performed to detect the required frames then convert the frames into images .This is done using unique frame detection approach. After this change image properities like brightness and contrast. Resize the image and change into YCbCr (luminance blue ,luminance red) .Analyse image using frame difference approach to identify background and foreground .In the next step ,perform feature extraction. Then perform object identification with threshold comparison.In the next step, perform hole filling using morphological operators

Unique Frame Identification

Frame difference calculates the difference between 2 frames at every pixel position and then store their absolute difference. It is used to visualize the moving objects in the form of frames. It consumes very less memory for performing the calculation.

Let us consider an example , if we take a sequence of frames, at every calculation the present frame and the next frame are taken into consideration and the frames are shifted(i.e after calculation, the next frame becomes present frame and the frame that comes next in sequence becomes next frame). Figure 3.4 shows the frame difference between 2 frames.

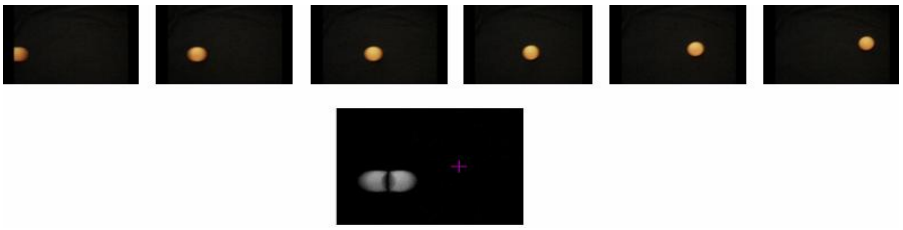

Figure 4: Frame difference between 2 frames

Algorithm for segmentation:

To perform the segmentation operation, frame difference algorithm is implemented as it takes less processing time. Frame difference algorithm performs separation of two sequential frames.

Algorithm for the segmentation as follows:

1. Read the input images
2. For (present position= initial position: final position)
   (a) Difference between the pixels values at current position of two images is calculated.
   (b) Calculate the absolute value
3. Store the difference in new image at same pixel position that is at present position

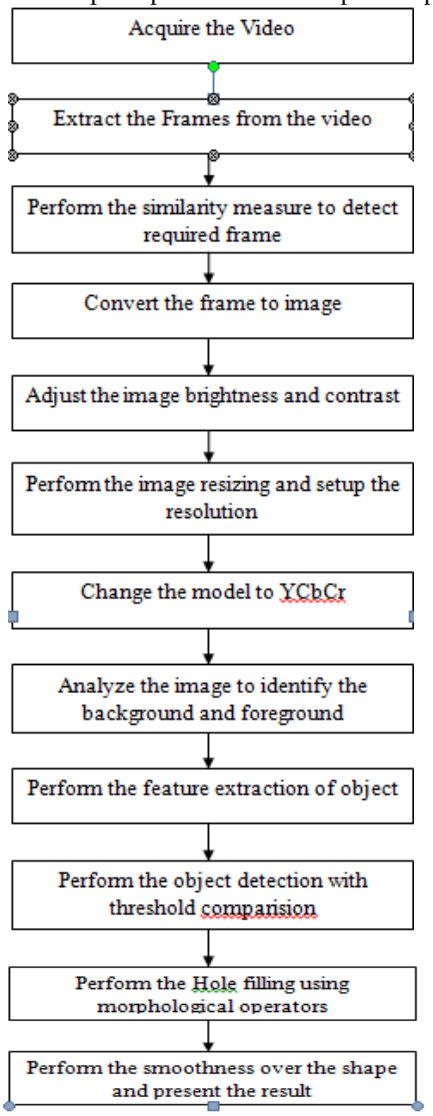

Figure : video segmentation stages

V. EXPERIMENTAL RESULTS

We implemented the method described above and tested it with images captured in the video. From video, images frames are created using wavelet based technique. Initially image segmentation is formed then video segmentation. Our approach for segmentation is frame difference because frame difference is the only algorithm which correctly remove the complex background, but unable to correctly identify the foreground element.

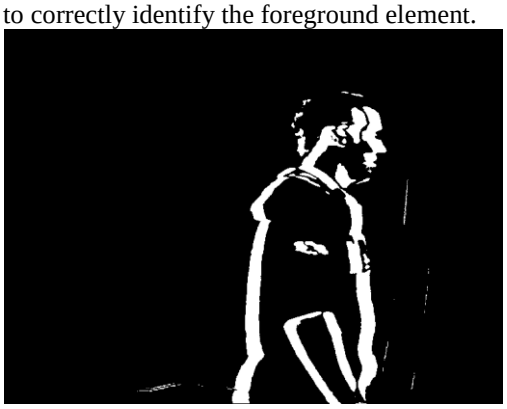

Figure : Using Frame difference approach

Our observations in frame difference approach is that algorithm correctly removes complex background in an video frame and it incorrectly removes the inside of an object .The criteria behind using frame difference approach is other approach like backplate difference which leaves complex background .

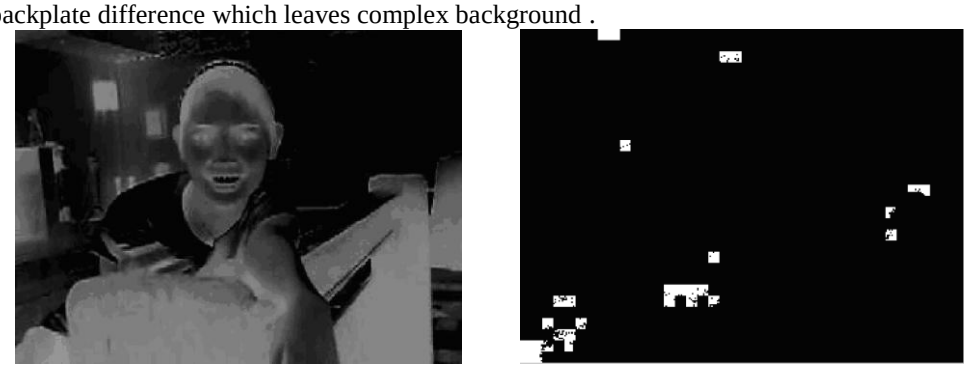

Figure: a and b are video frames using morphology operators

To provide the better view to the application as well as to provide the better user interaction we have generated a Graphical interface so that all the operations can be performed easily over the dataset. The GUI is basically divided in four stages

1. Image Extraction from Video
2. Wavelet based Frame Matching
3. Identification of Unique Frames
4. Blink recognition

VI. CONCLUSION

In this present work we have implemented the a hybrid model to perform the detection of some object in some image or the video. The presented model used the mathematical approaches to perform the object detection over the image and the video. At the initial stage, as the image or the video is accepted from the user, the preprocessing is performed to identify the image or video format and to extract the frame from the video. Once the extraction is performed the next work is to remove the noise from image to improve the accuracy level. At the next stage the similarity analysis between the images is performed. Now based on this analysis the object and the object features are identified. The obtained results shows that the presented work is effective enough to perform the detection of objects from the image or the video. The result is also analyzed for multiple videos. The results obtained from the work shows the effective detection of objects in video frames.

VII. FUTURE WORK

In this work we have performed the object detection process based on a mathematical model. The proposed work can be extended in different directions. One of such direction is to image the work on different classification approaches such as bays classifier, ART network etc.

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