JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

EYE DETECTION USING BILATERAL FILTER MODEL FOR BIOMETRIC SYSTEMS

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Abstract : **This paper presents the Eye detection using bilateral filter for biometric systems. The Eye detection plays an important role in the Biometric systems, which enabling robust and reliable identification and authentication of individuals. The existing methodology is convolution neural network (CNN). CNN is an artificial neural network, which it is used for image recognition and processing. Its built-in convolutional layer reduces the high dimensionality of images without losing its information. most of the existing eye detectors cannot efficiently determines the eye region, distinguish between left or right eye & detect the eye center in one round. The main drawback, it requires a large number of computations to execute, which can hinder real-time execution on low-cost, low-power devices. To overcome this drawback, the Bilateral filter is introduced in the place of CNN. A non-linear filter used for edge-preserving smoothing and noise reduction in images. The bilateral filter considers both the spatial proximity and intensity similarity of pixels when performing smoothing. It replaces the intensity of each pixel with a weighted average of intensity values from nearby pixels. The proposed method approach enhances the accuracy and robustness of eye detection, paving the way for advancements in biometric identification and authentication technologies.**

IndexTerms - **Face Detection, Feature Extraction, Bilateral filter, Haar Cascade, Eye detection**

I. Introduction

In the area of financial services biometric technology has been introduced, making lifeeasy for consumers and enhancing their protection at the same time. Use of biometric in financial and banking services have shown to be much safer than conventional waysof authentication. Health is the biggest aspect of our everyday existence. Security has acrucial part to play. Whenever citizens cross airports, use payment cards, access machines or cross high security zones, they must check their identification. In some instances, a username and a password are required, but personal identification cards areused in some circumstances. However, you can forget about user names and passwords,and you can lose or stolen identification cards.

This suggests that the methods of humanidentity must be strengthened and new techniques established, which are more accurateand specific than conventional ones. Current scientific and technical advancements have allowed individuals to be recognized by their biometrics. Currently, biometric authentication is used in many applications. Next, entry to restricted areas should be regulated. Secondly, it may be used in airport passenger screening and in border inspection. Thirdly, links to records and financial resources was applied. Latest new biometric identification carts and passports focused on irises or facial recognition systems have been released by the UK and Australian border authorities. The combination of iris technologies speeds up the protection search at some airports.

Interclass Correlations, ICV, Noisy Data, Spoofing, Non-universality Problems involve issues surrounding biometric systems, such as unimodal systems that offer us a higherFCR and a FRR. It would send us a bad individual in the end. Quality of the method. Other constraints enforced by unimodal biometrics may be strengthened by including several sources of knowledge to define an individual. Multimodal biometrics functions differently by integrating an authentication method or an authentication device, utilizing two or more biometric modes to shape one or both. The problem of non-universality is tackled using different characteristics, ensuring adequate populationcoverage.

The issue of spoofing faced by unimodal system is overcome by the multimodal biometric methods as multiple modality are combined together. An impostor will find it hard to connect many attributes to a real identity in tandem. The promise of multimodal biometrics for a very large variety of applications is growing. Examples ofbank security include ATM surveillance, cash transactions, card transactions, IT security programmes, computer login, etc.

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II. Literature survey

The breakthrough in the development of eye tracking technology started with Charles H. Judd. He assembled a non-invasive eye movement camera recording horizontal and vertical eye movements. A significant limitation of his invention was the inability to register changes in eye movements when the head was not still. Based on Judd's innovation, a pioneer in educational psychology, Guy T. Buswell demonstrated in his research that fixations and saccades change as a function of age and learning. In 1937, Buswell managed to record eye movements when watching images. The eye movements were photographed on the moving film.

A new and dynamic scheme based on face and iris fusion scores is considered by Maryam Eskandari and Omid Sharifi. Several fusion methods are implemented to thencompare results with this custom fusion method for recognition. This method has veryfast execution time due to the dynamic featured and fusion scores employed. The development of CIoT and its implementations has been supported in the development of the sensor and cloud technology. Researchers are yet to explore how the cloud basedIOT system infrastructure could be used for biometric recognition based on iris images.

Biometric systems are designed using and unimodal or multimodal approach. In the paper, a unimodal approach-based recognition system is developed using multiplebiometric traits. A new segmentation algorithm is proposed to mask and localize the iris region. For the extraction of iris functions, new algorithms, delta-medium and multitype algorithms are created. Any multi-modal biometric device uses many biometric features in identification of an individual.

Basma Ammour et al A multimodal approach that uses biometricfacial details and two iris, left and right, has been suggested. The subsequent fusion process to produce a satisfactory score is used. Extraction of features is key to every method of identification. In order to isolate the face and iris, 2D log Gabor filters are used, which are then used to distinguish them. The device offers a rather low 0.24% error rate and has been checked with several regular picture databases. It favor's a study with other approaches.

Anis Farihan Mat Raffei et al. In the research performed , we have a pattern detector for the Iris caught and triggered by visible light from many different wavelengths. It is incredibly challenging to catch a picture in poor light with low contrast that impacts iris position and further detection. In certain conditions, histograms focused on iso-contrast supports. The representation of the iris is split between regions and local intensity histograms and pixel intensity transfer methods are used. It was tested using image data sets that were developed. The findings revealed better outcomes for the suggested approach relative to the current low luminoustechniques.

In the period between the 1950s and 1960s, Russian psychologist Alfred Lukyanovich Yarbus performed a series of eye tracking studies which results are an important pillar of eye tracking technology. The findings showed that respondents' eyes would move according to their interest and the given task suggesting the correlation between fixation and interest.

III. EXISTING METHOLOGY

CNNs typically require large datasets to train effectively. This is because they learn to recognize patterns in data by analyzing many examples of those patterns. If the dataset is too small, the CNN may not be able to learn the patterns effectively and may perform poorly on new data. CNNs, or Convolutional Neural Networks, have played a significant role in many computer vision tasks, including eye detection. CNNs are a class of deep neural networks that are particularly effective at processing visual data due to their ability to automatically learn hierarchical patterns and features from images.

Overall, CNNs play a crucial role in eye detection by leveraging their ability to learn discriminative features from data and generalize well to new images. Their versatility and effectiveness have made them a cornerstone technology in various applications, including facial recognition, gaze tracking, biometric authentication, and driver monitoring systems. CNN is a powerful algorithm for image processing. These algorithms are currently the best algorithms we have for the automated processing of images. Many companies use these algorithms to do things like identifying the objects in an image. Convolutional Neural Networks specialized for applications in image & video recognition. CNN is mainly used in image analysis tasks like Image recognition, Object detection & Segmentation.

IV. DISADVANTAGES OF EXISTING METHOLOGY

They require a large number of computations to execute, which can hinder real-time execution on low-cost, low-power devices. CNNs also have shortcomings in terms of long training time, large data requirements, slow inference time, dynamic environment, and hardware dependency.

V. PROPOSED METHOLOGY

The bilateral filter is a technique used in image processing for smoothing images while preserving edges. In eye detection, it helps to reduce noise and enhance the clarity of eye features, making it easier for algorithms to detect and analyze eyes accurately.It considers both spatial closeness and intensity similarity between pixels, effectively balancing smoothing and edge preservation.In eye detection, it's often employed to enhance the clarity of the eye region by smoothing out noise while maintaining the sharpness of the eye boundaries. This way, it effectively reduces noise while preserving important details, making it useful in tasks like eye detection where both accuracy and clarity are crucial.

5.1. Filtering Techniques:

Spatial Domain Filtering: For each pixel in the image, a window centered around that pixel is defined. The filter computes the weighted average of pixel values within this window. The weights for averaging are determined by a Gaussian function of the spatial distance between pixels.

Intensity Domain Filtering: In addition to spatial distance, the bilateral filter also considers the intensity difference between pixels. It applies another Gaussian function to the difference in intensity values between pixels.

5.2. HAAR CASCADE

Haar cascade is an algorithm that can detect objects in images, irrespective of their scale in image and location.This algorithm is not so complex and can run in real-time. Haar cascade uses the cascading window, and it tries to compute features in every window and classify whether it could be an object.Haar cascade works as a classifier. It classifies positive data points → that are part of our detected object and negative data points → that don’t contain our object.Haar cascades are fast and can work well in real-time. Haar cascade is not as accurate as modern object detection techniques. It predicts many false positives. Simple to implement, less computing power required.

5.2.1 HAAR CASCADE CLASSIFIERS

As we saw in the previous section, we can extract features from an image, and use those features to classify objects. What are HAAR Cascade Classifiers: An object detection method that inputs HAAR features into a series of classifier (cascade) to identify objects in an image. They are trained to identify one type of object, however we can use several of them in parallel, for example, detecting eyes and faces together.

FIGURE 5.2.1.1: DETECTING EYES AND FACE

HAAR Classifiers are trained using lots of positive and negative image we then extract features using sliding windows of rectangular blocks. These features are single valued and are calculated by subtracting the sum of pixel intensities under the white rectangles from the black rectangles. However, this is a ridiculous number of calculations, even for a base window of 24 x 24 pixels (180,000 features generated).So, the researchers devised a method called Integral Images, that computed this with four array references.

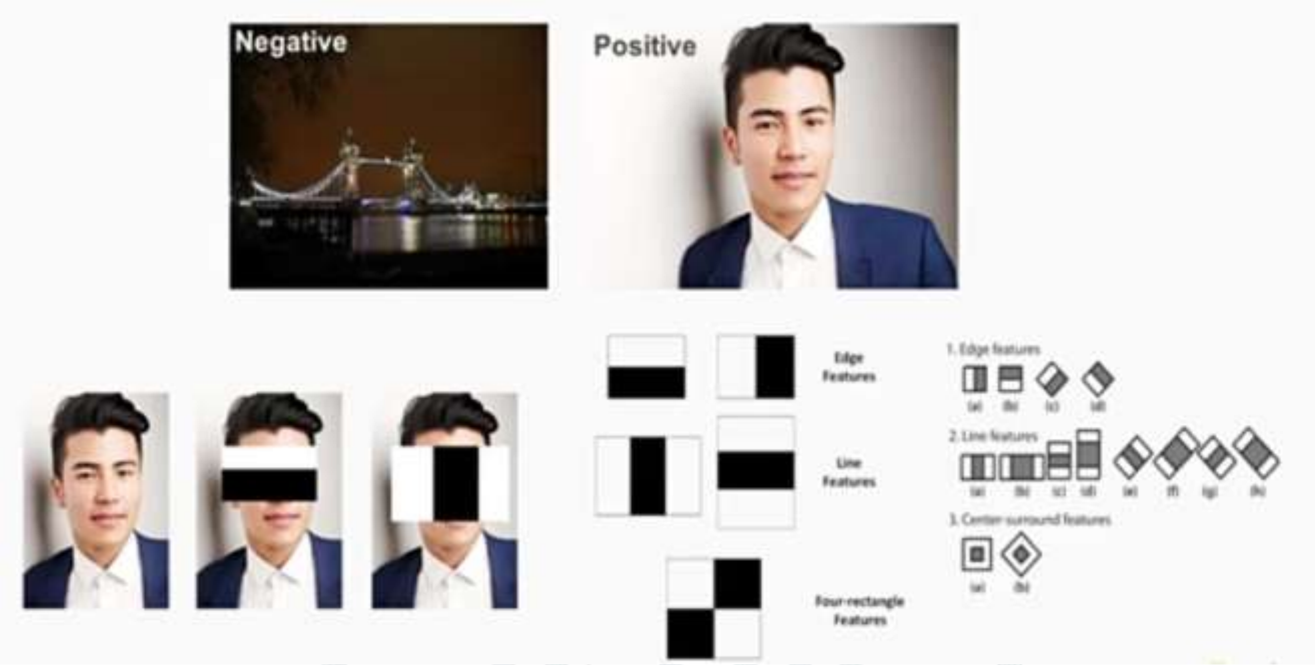


FIGURE 5.2.1.2: HAAR CASCADE FEATURES

RELEVANT

IRRELEVANT

5.2.2 FLOW CHART

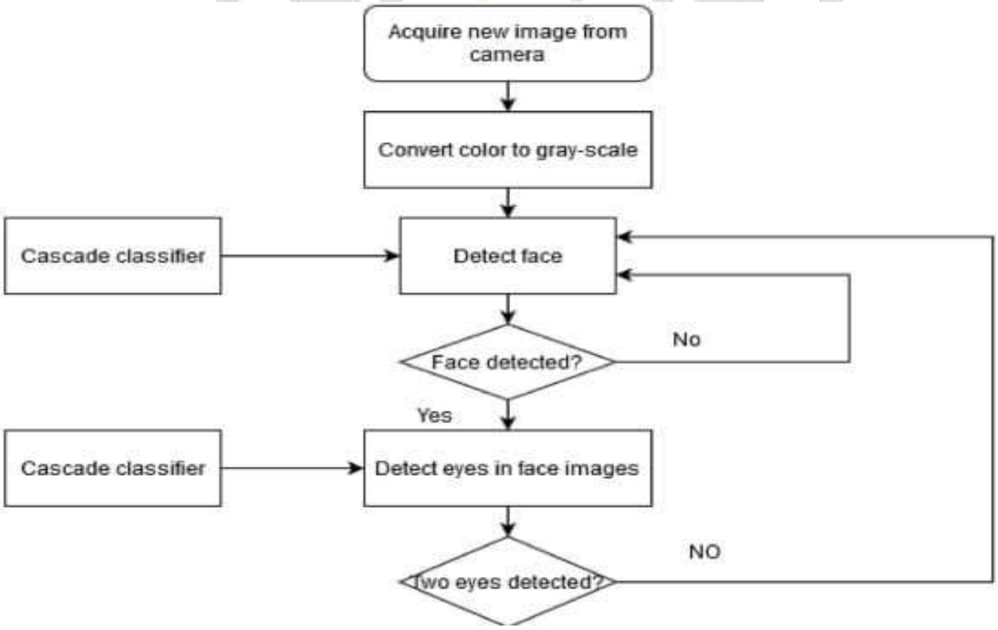


FIGURE 3.6: FLOW CHART FOR EYE DETECTION

VI. RESULTS AND DISCUSSION

Today's research in security application emphasis on biometrics where the individuals are identified accurately using biometric features in less cost and minimum duration. Iris recognition devices are the most diligent technique in multiple biometric applications. Research framework for eye biometric system is proposed where we analyzed how the input picture from the database is taken and pre-processed through bilateral filtering. Following the pre-processing, contour-based features such as, brightness, colour and texture are selected for the effective segmentation of iris sclera and pupil region for unconstrained eye images. Later entropy is calculated on the basis of the extracted contour-based features.

Data residing in the image can be differentiated based on entropy values which helps to perform segmentation accurately using CNN to cluster data in sclera iris and pupil region effectively. This section details about the performance of the proposed sclera, iris, and pupil segments methodology for noisy eye images as well as the outcomes from a proposed multi-algorithm feature extraction and a supporting value-based level fusion as with comparison of existing methodology.

Table 6.1: Entropy values for MMU database images

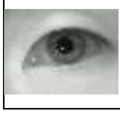
Labelled images	Entropy value	Classification Accuracy (%)
	10.84560658	88.74
	12.91781241	100
	13.18990281	100
	13.36857564	94
	13.72492633	98.3
	13.84040755	100
	13.87388653	100
	11.03423424	92.4
	11.3308829	100
	11.4825514	95.9

Table 6.2.: Entropy values for UBIRIS.v2 Database images

Labelled images	Entropy value	tion accuracy (%)
	10.84951952	94.3
	12.00494672	100

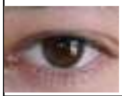
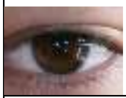
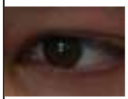
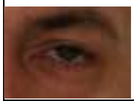
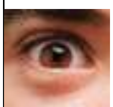
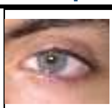
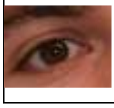
	14.08889121	100
	14.22193309	100
	13.4799699	100
	13.41671058	100
	13.56116364	100
	11.16364744	99
	10.93134463	98.64
	11.32630209	100

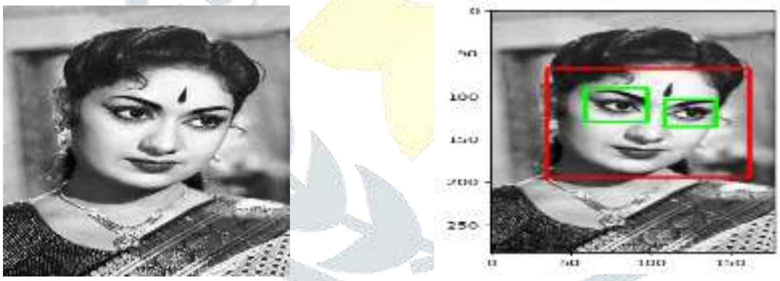
Table 6.3: Entropy values for MICHE Database images

Labelled images	**Entropy value**	**Classification accuracy (%)**
	12.61676788	84.63
	12.76722994	87.30
	13.21472949	92
	13.46816641	89.41
	13.84159043	95.32
	13.71539549	98.7
	11.6021496	76.81

	11.40044332	85.003
	12.01771534	92.01
	11.95272492	84.59

OUTPUT 1:

OUTPUT2:



Extract input image, which convert the input image based on the proposed methodology by using the algorithm. Imagine we have to detect the faces and eyes of humans. To proceed with this problem, we need to follow the steps: Detect Human faces**.** For every face, crop faces and pass it for eye detection**.** After getting the coordinates of the eyes (ex, ey , ew , eh) draw bounding boxes for the eyes on the original picture**.** Draw bounding box for faces using coordinates(x,y,w,h) on the original picture. The presented method demonstrates the efficacy of utilizing a bilateral filter model for eye detection in biometric systems. By effectively preserving edge information and reducing noise, the proposed approach enhances the accuracy and robustness of eye detection, paving the way for advancements in biometric identification and authentication technologies.

VII. CONCLUSION

Today security is major concern in computer technology as well as various applicationssuch as banking, e-commerce, military, health application, etc., Traditional knowledge based techniques such as using pincode, passwords, cards are not feasible because theycan be stolen, forgot or forged by third party. Biometric authentication is an alternativesolution for person identification as they are unique and their features are unchanged throughout person lifespan. Existing biometric system are facing some challenges suchas noisy input samples, occlusion and truncation, pose and orientation and changing luminance conditions, etc. Because of these issues, the biometric systems are vulnerableagainst security attacks. A better performance of biometric system can be achieved by overcoming some of these listed drawbacks by integrating multiple cues such as iris- fingerprint, iris-face, iris-voice, etc. There have been substantial studies to evaluate better ways of integrating multiple cues from different modalities. Fusion taken place at decision level is commonly preferred because it is simple as the minimal knowledge content accessible at this level. Therefore, researchers normally choose the corresponding score to merge, which would make the best compromises between the quality of knowledge and fusion simpler. One of the key issues with the score level fusion is the not often comparable values produced by various biometric matches. Characteristics and representation of these match score may be different. Therefore, there is need to normalize score value using slandered methodology.

Another drawback of existing biometric modality fusion techniques is that they are notable to secure data's in the database, especially in the area where high level security isneeded for authentication. There are several issues while providing security through biometric in multimodal eye recognition system. Our project emphasis on the accurate matching of authenticated person with multi-modal biometrics system. Here, at first the iris, sclera regions are adequately segmented utilizing entropy-based CNN clustering. After that, the effective features are extricated for all the iris, sclera, pupil segments and dependent on the extracted features support value is estimated. Matching score is at last determined to decide the data is recognized or Non-recognized.Using this multimodal biometric method then results in the accurate matching and authentication of the person. By utilizing feature level fusion, we combine the feature vectors, which in turn provide more data points for comparing the matching score.

In conclusion, the presented method demonstrates the efficacy of utilizing a bilateral filter model for eye detection in biometric systems. By effectively preserving edge information and reducing noise, the proposed approach enhances the accuracy and robustness of eye detection, paving the way for advancements in biometric identification and authentication technologies

VIII. ACKNOWLEDGMENT

Thepreferredspellingoftheword "acknowledgment" inAmericaiswithoutan "e" afterthe "g".Avoidthestiltedexpression, "Oneofus(R.B.G.)thanks..."
Instead,try"R.B.G.thanks".Putapplicablesponsoracknowledgmentshere;DONOTplacethemonthefirstpageofyourpaperorasafootnote.

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