A CREDIBLE WAY OF FACE RECOGNITION AND CLASSIFICATION SYSTEM IN VIDEO SCRUTINY

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Abstract

Modern facial recognition technology and other authentication methods are being added to computer vision applications. Unrestricted facial photos must require facial recognition. The method of identifying a face from digital photos is known as face recognition. It is the most significant and ongoing one in pattern recognition and artificial intelligence. The demand for numerous research projects used in real-time applications, including investigations, video frames, security and verification systems, is steadily rising. From the numerous input data to the static image or video sequence, facial expressions have to be recognised. Face detection and face recognition are just two of the many phases in the whole face recognition system. In this research, we presented a reliable system for face categorization and identification in video analysis. Several processes, including preprocessing, face identification, face feature extraction, matching, and classification tasks, are to be included in the suggested flow. The HAAM approach, also known as the hybrid active appearance model, uses face recognition. This technique aids in high memory operations for storage space, resulting in improved performance. The technique of extracting facial features from a face detection image, such as the eyes, nose, mouth, and other features, is known as feature extraction. In order to improve image quality, this research suggests a HAMM feature extraction method. In order to accurately forecast the human face's knowledge edge, the knowledge-based support vector machine (SVM) classifier have been utilised for classification. The simulation's output demonstrates that performance factors like accuracy, specificity, sensitivity, and precision have been examined.

Keywords – face recognition, video scrutiny, feature extraction, HAMM, knowledge based SVM method, accuracy, framing.

I. INTRODUCTION

The face is crucial when utilising biometrics to identify individuals. Face recognition technology has been developed by researchers for use in a variety of fields, including forensics, criminal detection, airport security, and face tracking.. In order to do face recognition, a video or inspection camera must be used to capture the face's image.

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Face recognition goes through several stages, including training with known photos, classifying with different categories, and database storage.

The system is given the test image from the saved image, which is categorised as a stored image. For a machine to recognise faces, there must be constraints placed on a variety of problematic mechanisms in the study world, such as variations in head attitude, changes in illumination, and changes in facial expression. Face detection, feature extraction, and face recognition are all required for face recognition to be automatically identified. Face detection, face normalisation, face feature extraction, and face matching are just a few of the different modules that make up the face recognition system. facial recognition involves comparing a facial image to every template in the database. This aids in locating the alleged identity. Images for face recognition must be tracked and identified using a variety of databases that have been kept. The figure.1 represents that there is the process of face recognition.

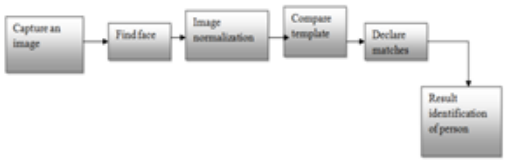

Figure.1 Face recognition process

1.1 HYBRID ACTIVE APPERANCE MODEL

The hybrid active appearance model (HAMM) is a computer vision method which is used to match the statistical method of the object shape and also appearance of the new image. This method contains the set of images which are combined together with the coordinates of landmarks are to be represented in all of the images. This is to be provided to the training supervisor. This method helps to differentiate between the current estimation of the appearance and that the target image to process the optimization methods. This HAMM method is to be related with active shape model (ASM). This ASM has the disadvantage like only used in shape constraints and does not take the available information across the target object. So to overcome the above problem, we propose a HAMM model. The figure.2 represent there is the example of hybrid active appearance model.

Labelled Image Points Shape Free Batch

Figure.2 Model of HAMM method

In section II contain information about face recognition methods are to be derived in different papers. In section III have details about face recognition feature extraction, HAMM methodology and clear explanation of the knowledge based method and measure the prediction accuracy. Details about the comparison of different physical parameters for the suggested methodology are provided in section IV, along with other pertinent data. The overall project

information and information on future developments for the proposed work are provided in section V.

II. RELATED WORK

Using Gabor, principal component analysis, and SVM methods, Meijing Li [1] et al. suggested a face recognition technology development in a lighting-normalized environment. Using a histogram combination, the authors of this study present a number of different methods for solving full illumination variation problem. This paper includes the steps of normalising the lighting, equalising the histogram, applying a Gaussian low pass filter, extracting features using Gabor wavelets, performing a PCA, classifying using an SVM, analysing data set performance, calculating standard deviations, and so on. Accuracy of face recognition is one metric that will be used to evaluate how well the aforementioned techniques perform. The next step for this paper is to apply the illumination method to other types of bioimages, such as X-rays and mammograms. W.Sylvia Lilly Jebarani [2] et al. presented a PNN-SIFT to improve the image processing system for recognising and categorising faces. Preprocessing, facial feature recognition, feature extraction, and classification are all covered in this work. In this paper, we will use a scale-invariant feature transformation method to extract features. The extraction efficiency is higher with this procedure. A probabilistic neural network (PNN) will be created to categorise facial images. The simulation results demonstrate that sensitivity, specificity, precision, accuracy, and recall will be used to assess performance. The following data, including preprocessing, is included. Sensitivity, accuracy, precision, and specificity in recognition performance analysis including face identification, key point selection, feature extraction, matching, and classification. A powerful face identification and classification system using DCP and SIFT image processing techniques was proposed by W.Sylvia Lilly Jebarani [3] et al. Using a scale-invariant feature transform, this strategy aids in partial facial identification. When applied together, the aforementioned methods produce a more accurate and reliable recognition mask when compared to other methods of facial recognition. Robust point set matching compares and matches the faces in the gallery image with the ones in the probe face image. The simulation and outcomes will serve as a representation of the performance analysis. Sensitivity, specificity, accuracy, recall, and precision are just few of the metrics that will be used to evaluate performance.

To facilitate facial identification, Saranya R. Benedict et al. [4] proposed extracting geometrically structured facial features. This technique is useful for pinpointing the excised individual's eye's centre and corner. This is useful for debugging and testing the system's eye detection and eye localization components. To

speed up the process of eye localization, this work employs a two-pronged approach: first, a Gabor filter is used to identify distinctive eye patterns; second, a support vector machine (SVM) classifier is used to pinpoint precise coordinates. Parameters including localization time, detection accuracy, and true positive rate will be used to evaluate the simulation and performance. The study covers topics including setting up the system, locating the eyes (from their centres to their fiduciary points), and analysing performance. With commercially available, pre-trained CNNs, R. Raghavendra et al. [5] suggested a transgender face recognition system. In this research, we will suggest a solution to one of the problems with existing face recognition systems: how to accurately identify different participants when enrollment photos must be pre- changed. In this research, we will develop a novel framework that makes use of an improved and fine-tuned version of the deep residual network-50. Information such as the proposed methodology, which is founded on transfer learning with the aid of a pre-trained deep CNN, can be found in the paper. The evaluation will look at the evaluation protocol, the discussion of the evaluation protocol, and a comparison analysis to determine the results. When compared to other methods, the results presented in this paper are more accurate. Improved face identification at low resolution using LBPH was proposed by Aftab Ahmed et al. [6]. This research presented a system for recognising a person's face while it was moving in different directions and at different angles. This work introduces several techniques, such as local binary patterns histogram, that are utilised to deal with low-resolution human recognition. Face detection, feature extraction, data set, feature vectors, face image recognition, and performance analysis are all covered in this work. The simulation results demonstrate a study of known or unknown individuals. This article will be expanded upon to examine the huge benefit for security services in identifying criminals. Unconstrained face recognition presents new difficulties for deep learning, as Guodong Guo [7] and colleagues have pointed out. This research contributes to the evaluation of the recognition performance of cutting-edge deep networks by classifying facial photos into distinct attributes. High-accuracy deep learning will be used to evaluate performance, as it is capable of unrestricted facial recognition. Face images, data sets, protocols, light convolutional neural networks, face neural networks, face recognition evaluation in identification, verification, and centre loss, and performance analysis are all covered in this paper.

Using the Dlib and Opencv libraries, Nataliya Boyko et al. [8] proposed a performance assessment and comparison of software for facial identification. In this study, we present a strategy

for broadly using facial recognition. This study presents and formulates the core scientific framework for automated facial recognition. This paper will show the results of a comparison of the two libraries, including an examination of the correlation between the number of iterations and execution time of the applied algorithms. We will examine how well the libraries perform for facial recognition and make predictions. The study includes the following sections: materials and methodology; analysis of performance. Proposals for recognising faces, exchanging faces, and segmenting faces were made by Yuval Nirkin [9] and colleagues. The conventional fully convolutional network is used for face segmentation in this paper, which allows for incredibly quick and precise segmentations. This paper contributes to the partitioning of robust face switching under novel circumstances. Face swapping in unconstrained images, 3D face shape fitting, deep face segmentation, face swapping and blending, performance analysis of face segmentation results, qualitative and quantitative face swapping results, and verification protocols and results from intra-subject face swapping are all covered in this paper. Better estimating blends for the merged faces are described in detail in the simulation result.

III. PROPOSED METHODOLOGY

We suggested a reliable method of face categorization and identification in video analysis. [10] Several processes, including preprocessing, face detection [11], face extraction, matching, and classification tasks [12], are to be included in the suggested flow. The HAAM approach, also known as the hybrid active appearance model, will use face recognition. [13] This technique aids in high memory operations for storage space, resulting in improved performance. [14] The technique of extracting facial features from a face detection image, such as the eyes, nose, mouth, and other features, is known as feature extraction. In order to improve image quality, this research suggests a HAMM feature extraction method. In order to accurately forecast the knowledge edge of the human face, the

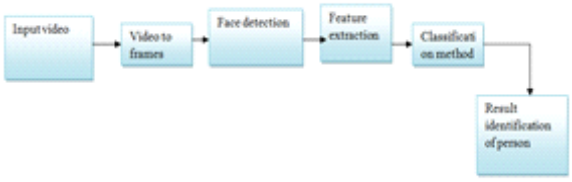

Figure.3 Steps of face recognition method

3.1 FACE DETECTION

The main step in face recognition algorithms is face detection. Predicting when a human face will emerge in the video frame and where it will be placed aids in the face detection process. The facial recognition system will become more reliable and simple to create as it advances. The operation of the face alignment helps to explain the scales and orientations of different patches. One of the processes in the face recognition process's preliminary processing is face detection. The pseudocode shown below shows that the facial recognition method's analysis

of the detection process has been done.

Pseudocode

Initialize image_set

For $F_{frames} = 1, 2 \ldots N$

evaluate feature vectors

project image

estimate measure of fitness

accumulate the fitness

eliminate the image with low fitness value

update image_set

end

identify highest accumulated fitness value is to be used.

3.2 FEATURE EXTRACTION

The most important step in facial recognition techniques is feature extraction. When the different regulations are knowledge-based SVM classifier methods are finally to be utilised for the classification process**.** [15]

3.2 FACE RECOGNITION PROCESS

The newest technology used to detect or recognise a person from a variety of digital photos or a video frame from a video source is called a face recognition system. [16] The different facial expressions, such as head rotation, lighting intensity, and angle, make face identification particularly challenging. In this work, face identification from video frames is the main topic. We want to determine who is inside this video frame and where their face will be located. The primary objective stated above will therefore be processed through a number of processes including face detection, feature extraction, key point classifier, identification process, and identification process. The figure.3 shows that there are the processing steps of the face recognition method. [17]

To be applied in this approach, the image subset is to be extracted. The hybrid active appearance model will be employed in this study for this step. Through dimension reduction and a clear explanation of appearance, this strategy increases the feature selection. The feature extraction assists in reducing system redundancy. [18]

3.3 HYBRID ACTIVE APPERANCE MODEL

TOne of the most effective methods based on the appearance representation of images is the hybrid active appearance model. When it is assumed that the gradient matrix will be fixed and have optimal coefficients for all images, a complex method is avoided thanks to HAMM. [19] Several training photos will be used to create this gradient matrix. The hybrid gradient matrix, which aids in wide range prediction with the right update direction, will be used. Owing to the texture Eigen vectors included in the target texture, the gradient matrix will be determined. The evaluation of the hybrid gradient matrix is shown below.

$$\Psi_{hybrid} = (Tex_{mean}) + \sum_{p=1}^{NTex_{current}} (Tex^{(p)}_{current\_optimum} (Tex_p) + (\Gamma) \quad \text{---------- (1)}$$

In the above equation,

Ψ_{hybrid} represents that the hybrid gradient matrix, Tex_{mean} denoted as texture mean,

$Tex^{(p)}_{current\_optimum}$ $Tex^{(p)}_{current\_optimum}$ is denoted as average of the pth optimal texture coefficient over the training images, Tex_p Tex_p is denoted as texture Eigen vectors.

The basic gradient matrix is given below,

$$\Psi_{hybrid} \cong (Tex_{mean}) + \sum_{p=1}^{NTex_{current}} (Tex^{(p)}_{current\_optimum} (Tex_p) + (\Gamma) \quad \text{----------} (2)$$

The better result for the texture coefficients is obtained. These are to be given for increasing the better estimates gradient matrix. Finally, the hybrid gradient is given by,

$$\Psi_{basic} \cong (Tex_{mean}) + \sum_{p=1}^{NTex_{current}} (Tex^{(p)}_{current} (Tex_p) + (\Gamma) \quad \text{----------} (3)$$

Where, $\phi_p = [Tex_p, Tex_{p'}]_p$ is denoted as updated terms during HAMM's training process.

The below algorithm represents there is the analysis of the hybrid active appearance model flow.

Algorithm

Step.1 The current AAM parameters are to be used and the target image can wrap into the normalized frame. As a result of the normalized texture will be obtained which is denoted as Tex_{norml}.

Step.2 From the normalized frame, the synthesized texture will be evaluated which is denoted as Tex_{synth}.

Step.3 The error will be evaluated that is

$$E_r = Tex_{norml} - Tex_{synth} \quad \text{----------} \quad (5)$$

Step.4 The formula shown below should be used to evaluate the texture coefficients.

$$Tex_{coeff} = \begin{bmatrix} DCom\_vec_{shape} \\ Com\_vec_{tex\_coeff} \end{bmatrix} \quad \text{----------} \quad (6)$$

Step.5 The hybrid gradient matrix will be evaluated based on the equation (3)

Step.6 The Ψ_{hybrid} and Ψ^{T}_{hybrid} Ψ^{T}_{hybrid} are to be evaluated with efficiently. $\Psi^{T}_{hybrid}\Psi^{T}_{hybrid}$ is denoted as the small matrix.

Step.7 The parameters are to be updated and compute the new error (Γ_{new_err}) (Γ_{new_err})

Step.8 If $\| \Gamma_{new\_err} \Gamma_{new\_err} \|^2 < \|$ $\|^2$ then it is accept the update.

The figure.4 represent that there is the analysis of the hybrid active appearance model flow method.

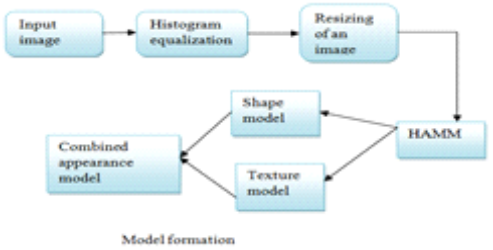

Figure.4 HAAM model formation

3.4 CREDIBLE WAY OF CLASSIFIED USING KNOWLEDGE BASED SVM

The knowledge-based SVM aids in improving predicted accuracy while lowering the number of training data required. SVM is a main component of digital image processing in the classification problem. The knowledge base must include only of cubes that fall into one of two categories. It is important to consider the single knowledge set as a generalisation of the training data, which consists of just one point in the input space. Figure.5 indicates that there is an SVM analysis for the face

detection based on the knowledge. This method is used to describe the features of the face in easy way. From the input images, the facial features are to be extracted and then face candidates are to be identified. [20]

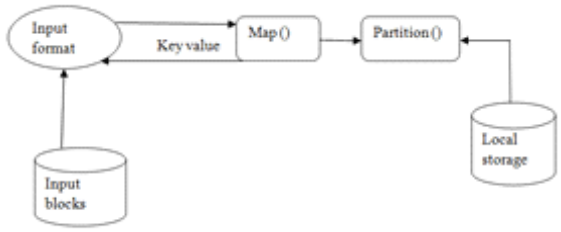

Figure.5 Knowledge based SVM classification

The below algorithm gives there is the clear explanation of the knowledge based SVM present in the face recognition process.

Algorithm

Knowledge based SVM classification algorithm.

Input: data pairs (A_p, B_p), rule_set R_s

Step.1 Remove all data pairs (A_p, B_p), which are based on the rules are sufficient by correctly classifying them.

Step.2 For 'f' to be obtained, the usual SVM classification problem must be addressed on the remaining data.

return $\varphi o f \varphi o f$ $\|\varphi o f \varphi o f$ is denoted as the composition functions.

The simulation and results indicate that the examination of performance factors including accuracy, specificity, sensitivity, and precision will be conducted.

IV. SIMULATION AND RESULT DISCUSSION

We suggested a reliable method of face categorization and identification in video analysis. Several processes, including preprocessing, face detection, face extraction, matching, and classification tasks, are to be included in the suggested flow. The simulation and results indicate that the examination of performance factors including accuracy, specificity, sensitivity, and precision will be conducted. Our existing method is active appearance model present in various papers.

Accuracy

More of this has to be done with imbalanced data sets. [21] It is determined by dividing the summation of the true negative, true positive, false negative, and false positive values by the addition of the true positive and true negative values (Tp, Tn).

$$\mathbf{ACC = (T_p + T_n) / (T_p + T_n + F_p + F_n) \text{ --- } (7)}$$

The accuracy in terms of the reference faces was analysed and compared to both the existing and suggested methods, as shown in the table.1 and figure.1.

Number of reference faces	Existing method	Proposed method
1	50	55
100	60	65
200	70	75
300	74	79
400	79	82
500	80	89

Table.1 Accuracy analysis of existing and proposed methodology

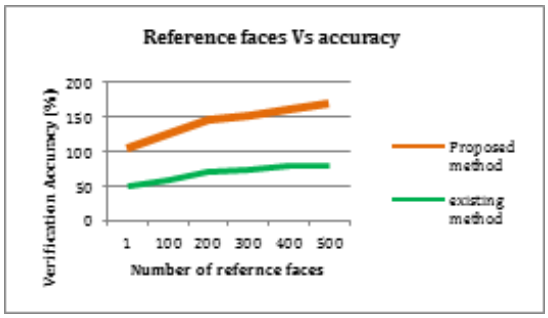

Figure.6 Accuracy analysis

Precision-Recall

This is the fraction of the retrieved documents which are to be relevant to the query. This is used with the recall which is nothing but the all relevant documents are to be returned by the search.

$$\textbf{Precision} = T_p / (T_p + F_p) \text{ ------ (8)}$$

$$\textbf{Recall} = T_p / (T_p + F_n) \text{ -------- (9)}$$

It is also called as positive predictive value.

Recall	Existing precision	Proposed precision
0	1	1.5
0.1	0.67	0.87
0.2	0.63	0.83
0.3	0.55	0.75
0.4	0.45	0.65
0.5	0.41	0.61
0.6	0.36	0.56
0.7	0.29	0.49
0.8	0.13	0.33
0.9	0.10	0.25

Table.2 Recall precision analysis

The figure.2 and table 2 represented that there is the analysis of the recall and precision method.

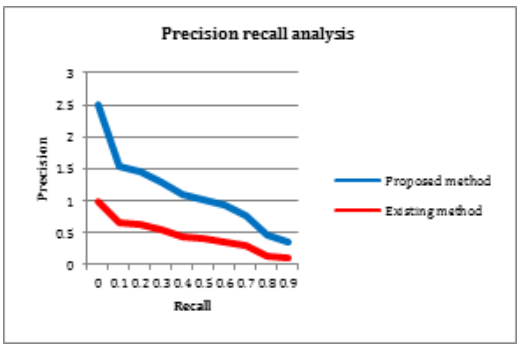

Figure.7 Precision analysis

Specificity-sensitivity analysis

The true positive rate (TPR) analysis determined by the proportion of real positives that are to be precisely determined, is what is used to define sensitivity.

$$\textbf{TPR} = T_p / (T_p + T_n) \text{ --- (10)}$$

The term "specificity" is frequently used to describe the need to assess and identify true negative rates (TNR) for actual negatives.

$$\textbf{TNR} = T_n / (T_n + F_p) \text{ ---------- (11)}$$

Specificity (1-specificity)	Existing method sensitivity	Proposed method sensitivity
0	0	0
0.2	0.4	0.55
0.4	0.6	0.75
0.6	0.8	0.9
0.8	0.82	0.92
1	0.85	0.95

Table.3 Specificity and sensitivity analysis

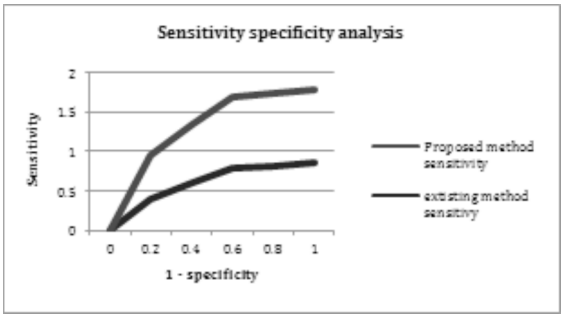

Figure.8 Analysis of specificity and sensitivity

V. CONCLUSION

We suggested a reliable method of face categorization and identification in video analysis. Several processes, including preprocessing, face

detection, face extraction, matching, and classification tasks, are to be included in the suggested flow. The HAAM approach, also known as the hybrid active appearance model, will use face recognition. This technique aids in high memory operations for storage space, resulting in improved performance. The technique of extracting facial features from a face detection image, such as the eyes, nose, mouth, and other features, is known as feature extraction. In order to improve image quality, this research suggests a HAMM feature extraction method. In order to accurately forecast the human face's knowledge edge, the knowledge-based SVM classifier methods have to be utilised for the classification. The simulation and result demonstrate that when compared to current processes, the proposed solution will yield better results.

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