Original Article

Improved Accuracy of Face Recognition System to Identify Criminal Based on Innovative Feature Extractor to Improve Accuracy Using Deepface over LBPH Algorithm

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Abstract

Aim: Criminal face recognition system helps in identifying the suspect and also helps in retrieving information about the suspect. Innovative Deepface algorithm is used for the face recognition method. **Materials and Methods:** Face detection for identifying the criminals is performed using Deep Face (N=10) over LBPH model (N=10) with Gpower of 80% and alpha =0.05, with split size of 70% and 30 % for training and testing model respectively. **Results:** It is found that the accuracy of Deepface is 91.90% which is higher than the LBPH model 90.80% and attained the significance value of p=0.0294 (p<0.05), showing that there is a significant difference between the groups.. **Conclusion:** For the face identification purpose Innovative Deepface algorithm is preferred than LBPH algorithm.

Keywords: Facial Image, Innovative Deepface, Image Classification, Machine Learning, Local Binary Pattern Histograms (LBPH).

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INTRODUCTION

Crime rates are increasing rapidly and it is a difficult task to find a suspect faster. Generally, biometrics like fingerprints are used for identifying the suspect. With the help of face recognition we can identify the suspect which helps in solving the crime incident faster. This face recognition system is based on facial biometrics (Higgins et al. 2021). With the use of face recognition, criminal identification can be done. The criminal face recognition system takes the image of a person and recognizes them, this application follows the machine learning procedure, trains itself from the image and gives out accurate results. For example, if a crime is recorded in a surveillance camera , the image of the suspect will be captured and it gives out the matching data. Computer based face recognition systems are mature and reliable (Wei et al. 2020). Criminal face identification system is widely used for criminal investigation procedures in forensic for identifying the victim (Valentine and Davis 2015). In criminal investigation for finding the suspect (Abdullah et al. 2017).

Around 35 articles in the IEEE Xplore, 20 articles in ScienceDirect and 15 articles inGoogle Scholar were published in the past 5 years. Facial image classification is a fastest growing technology which makes developers and researchers implement more. Face recognition using deep learning and machine learning is more effective and accurate (Brownlee 2019). Deep face helps in utilizing facial biometrics for immediate recognition (Taigman et al. 2014). Deepface gives efficient results compared to Local Binary Pattern Histograms (LBPH) (Srisuk and Ongkittikul 2017). Innovative Deep face algorithm helps in achieving results faster (Mokalla and Bourlai 2019). Among these articles, the best article is (Taigman et al. 2014) as this concludes that deep learning is effective. Our team has extensive knowledge and research experience that has translate into high quality publications(Bhansali et al. 2021; Jayanth et al. 2021; Sudhakar, Ravel, and Perumal 2021; Sathiyamoorthi et al. 2021; Deepanraj et al. 2021; Raju et al. 2021; Arun Prakash et al. 2020; Kamath et al. 2020; Shanmugam et al. 2021; Rajasekaran et al. 2020; Adhinarayanan et al. 2020; Rajesh et al. 2020; Aurtherson et al. 2021)

From this literature survey, it can be concluded that the Criminal Identification system helps in identifying criminals using image classification methods and makes the process faster than manual. Using the Innovative

Deepface algorithm as the previous algorithms is having less accuracy and consumes more memory, deep face algorithms analyze the image and find the distance in it.

Materials and Methods

The study setting of the proposed work was conducted in Web Ontology Laboratory, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences. In this research model, there are two groups one group refers to Deep face and the other group refers to Local Binary Pattern Histograms (LBPH). Sample size was calculated using clincalc analysis, 10 sample sizes estimated per group, totally 20 samples with alpha and beta value 0.05 and 0.2, 95% confidence, pretest power 80% and enrolment ratio 1. In this study, the accuracy of two classifiers Deep face and LBPH was compared (Wei et al. 2020).

Deep Face Algorithm

Innovative Deepface is the most lightweight facial image recognition library used in python. Deepface uses machine learning and AI models for face recognition. Deepface extracts details like age, gender, emotion by extracting attributes from an image (Ayat et al. 2019).

Pseudocode for Deepface Algorithm

Step 1: Import required dataset for training and testing.
Step 2: Read the facial image for image classification.
Step 3: Convert image into BGR format for face recognition.
Step 4: Evaluate the final result.
Step 5: Calculate the accuracy for Deepface algorithm as shown in Equation (1)

$$\text{Accuracy} = \frac{Number\ of\ correct\ predictions}{Total\ Number\ of\ predictions} \text{x } 100\% \quad (1)$$

Local Binary Pattern Histograms (LBPH) Algorithm

Local Binary Pattern Histograms is a powerful feature extraction technique to describe facial images. Local Binary Pattern Histograms (LBPH) is a simple yet efficient texture operator which labels the pixels of an image. Using LBP with Histograms we can represent the face images. For the sample preparation, LBPH algorithm is implemented for group 1.

Pseudocode for LBPH Algorithm

Step 1: Import required dataset for training and testing.
Step 2: Call LBPH_recognizer method for image classification.
Step 3: Start comparing the facial images.
Step 3: Evaluate the final result.
Step 5: Calculate the accuracy for LBPH algorithm.

For the training and testing purpose of the Innovative Deepface algorithm, a computer with AMD Ryzen 5 (3550H) 64 bit processor, 8GB RAM of memory and this model is developed using python language of version 3.8. The dataset has been collected in the image format from google which consists of different facial images and these same datasets were used for both the training and testing purpose.

Statistical Analysis

Statistical software used in the study is the IBM SPSS version 28. The independent sample t-test calculation for analyzing equal variance, standard error, and levene's test are evaluated. The SPSS was also used for evaluating the accuracy of the algorithms namely Deepface and LBPH algorithm. Attributes like face_recognition are the independent variables and face_detect, face_rec are the dependent variables (Wei et al. 2020).

Results

After the completion of analysis, the results show that Local Binary Pattern Histograms (LBPH) is having accuracy of 90.80% and accuracy for Deepface is 91.90%. Therefore, the Deepface algorithm is more efficient and accurate in image classification. Table 1 consists of the Accuracy and Accuracy loss value of both the Deepface and LBPH algorithms. Table 2 consists of the statistical analysis performed to obtain the Mean, Std. Deviation and Std. Error Mean values for Accuracy values of LBPH and Deepface. Table 3 provides information for independent sample t-test was performed to obtain t-test Equality. Comparison of these two algorithms is presented using a bar plot with error rate included as shown in Fig. 1.

Discussion

From this study, it can be concluded that the Deepface algorithm which has 91.90% is significantly better than the LBPH algorithm which has accuracy value of 90.80% in detecting the facial image. For the testing purpose, the face detection model is used both for training and testing, each sample group gives us different results. For training the dataset, 80% of images having people's faces and also for testing 80% of images were used from the dataset.

Deepface is capable of recognizing blurred images while other algorithms show less recognition rate (Higgins et al. 2021). Each feature in an image is considered as the nodal point and each face image consists of around 80 nodal points, Deepface is suitable for face recognition and classification of messages (Geremek and Szklanny 2021). Deepface uses machine learning procedures such as Google Facenet, Facebook Deepface, Visual Geometry Group (VGG) Face which gives out efficient results (Ratha, Patel, and Chellappa 2021). High accuracy was observed in the deepface algorithm as it takes 128 measurements from each facial image and notes the recognizable points in a human face (Geitgey 2018).

Limitations of Deepface algorithm will extract data of the entire image hence recognition time is less. This requires large data sets and 3D modeling is complicated. In future the Criminal Face Identification system can be developed by increasing recognition rate and higher accuracy rate can be achieved by larger datasets.

Conclusion

After analyzing the results, the Deepface algorithm for Criminal face detection is better than the LBPH algorithm in terms of accuracy and this LBPH algorithm can be implemented for further development.

Declaration

Conflict of Interest

No conflict of interest in this manuscript.

Author Contributions

Author TS was involved in data collection, data analysis, manuscript and for writing Author WDP was involved in conceptualization, data validation and critical review of manuscript.

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Tables and Figures

Table 1. Accuracy and Accuracy loss values for Deepface and LBPH Algorithm for face detection and identification

FACES	Deepface		LBPH	
	Accuracy	**Accuracy loss**	**Accuracy**	**Accuracy Loss**
1	95.0	5.0	94.0	6.0
2	91.0	9.0	90.0	10.0
3	89.0	11.0	88.0	12.0
4	93.0	7.0	92.0	9.0
5	92.0	8.0	94.0	6.0

6	88.0	12.0	91.0	9.0
7	92.0	8.0	85.0	15.0
8	95.0	5.0	94.0	6.0
9	94.0	6.0	87.0	13.0
10	90.0	10.0	93.0	7.0

Table 2. Descriptive Statistical value of mean, std.Deviation, std Error Mean value for Deepface and LBPH with ten optimal accuracy values. There is a statistically significant variation in accuracy values between Deepface (91.90%) and LBPH (90.80%).

	Algorithm	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Accuracy	**Deepface**	10	91.90	2.424	0.766
	LBPH	10	90.80	2.943	0.930
Accuracy Loss	**Deepface**	10	8.1000	2.424	0.766
	LBPH	10	11.0000	2.943	0.930

Table 3. Independent Sample t-test is applied for the dataset fixing confidence interval as 95% and level of significance as p=0.046 (p< 0.05) (Deepface showed significantly more accuracy than LBPH)

Accuracy	**Levene's Test for Equality of Variances**		**t-test for Equality of Means**						
								95% Confidence Interval of the Difference	
	F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**Lower**	**Upper**
Equal variances assumed	1.168	0.0294	0.862	18	<0.01	2.900	1.206	0.366	5.433
Equal variances not assumed	-	-	0.862	16.774	<0.01	2.900	1.206	0.359	5.444

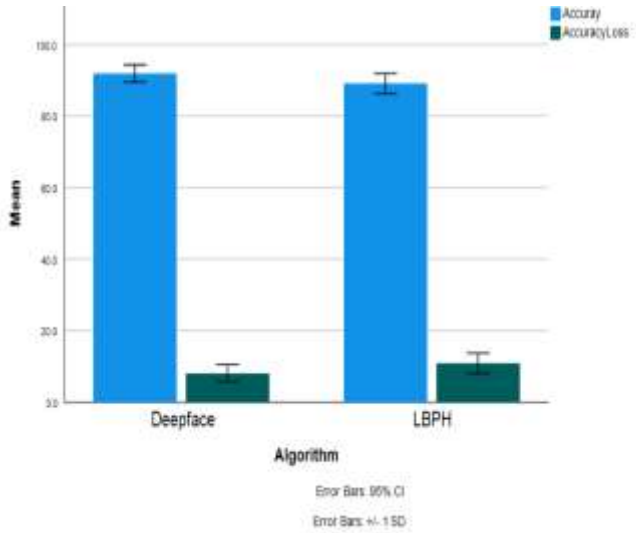

Fig. 1. Bar graph comparison between Deepface (showed 91.90% accuracy) and LBPH (showed 90.80% accuracy) in terms of Mean Accuracy. Deepface showed significantly higher accuracy and slightly better standard deviation than LBPH. X-axis: Deepface vs LBPH, Y-axis: Mean Accuracy of detection ± 1 SD.