



Face Detection & Recognition System for Sport Celebrities Using Imag Dataset

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Abstract—

Face detection and identification in real-world settings present many challenges due to lighting variations, pose variances, and occlusion of the face. In this paper, we provide a strong system for detecting and identifying sports celebrities using face images with both traditional machine learning and deep learning techniques. The proposed system employs two different face detection methods (Haar Cascade Classifier and Max Margin Object Detection (MMOD)) and two different recognition methods (Local Binary Patterned Histogram (LBPH) and Pruned ResNet) as CNN-based techniques to identify faces [1].

A sports celebrity image dataset has been used for an extensive series of experiments. This dataset has also been used in conjunction with a publicly available dataset containing images from 31 celebrities in frontal views for face detection and recognition. Multiple combinations of methods have been tested and evaluated to determine the most appropriate model for the recognition of faces in images. The analysis of the results shows that the MMOD detector using a Pruned ResNet model provides the best results in terms of accuracy [2].

The performance differences of structured datasets contrastingly to unstructured real-world image data is compared in addition to a very important need for strong feature extraction/recognition detection techniques. Proposed system is highly successful at increasing the efficiency of recognition in unfavourable situations making it practical for potential applications including; surveillance, sports analytics and automated identity recognition [3].

Keywords - Face Detection, Face Recognition, Multi-task Cascade Object Detection (MMOD), Haar Cascade, Local Binary Pattern Histograms (LBPH), Convolutional Neural Networks (CNN), Pruned ResNet, Sport Celebrities, Image Processing.



I. INTRODUCTION

In contemporary biometric and computer vision applications, facial detection and recognition are critical technologies as they enable advanced automated processes for face detection, identification, and recognition in places such as public safety, sports, and analysis of images through various automated methods. While humans have an innate ability to recognize faces across multiple lighting levels, head positions, and expressions; replicating this level of recognition by machines continues to be a challenge [1]. A Face Detection and Recognition System for Sports Celebrities Using Image Datasets (this system) is an example of a computer-based system that automates the face detection to match the person in the photograph or video clip to a pre-specified celebrity(s) based on extracted facial features. Accurate identification and matching to a person will occur through the use of extracted facial features as identifiers through their respective databases. This system will use both classical and deep learning techniques to maximize performance for face detection and recognition. Feature extraction and dimensionality reduction for machine learning purposes will be performed by using Principal Component Analysis (PCA) to reduce computational complexity[3]. Additionally, new techniques for detecting and identifying patterns can deal with the differences found in our day-to-day lives [4]. With the rapid expansion of digital images available to the public, face should no longer be used as a manual means of identification[5]. If we automate the process of identifying individuals using facial recognition technology, it would increase the processing speed, accuracy, quality, and scalability of all types of different applications[6]. Automated systems for facial recognition may provide such benefits as enhanced productivity, improved results, and more scalability, all driven by the increasing number of available digital images[7].

1.1 Objectives of the Project

The main goal of this project to develop an automated system that detects and recognizes facial images from real-life objects and creates a model that will be able to perform its task of

recognition consistently under varying conditions including; lighting, facial poses, and when partly hidden from view any of these variations would provide hurdles for any algorithm to overcome that was trained to recognize only one condition at a time.

In order to achieve the goals stated above a number of methods were used for the purpose of detecting and recognizing out of a dataset of images, of which the majority of these methods were comparative evaluations between two classes of Algorithms: one to detect Human Faces "Haar Cascade Classifier", one "Max-Margin Object Detector (MMOD)" of these types of Algorithms; and, another to classify the Faces of these images into one of four categories: the first was "Local Binary Pattern Histogram (LBPH)", the second "Convolutional Neural Network (CNN)-Based Pruned ResNet Model", all within the context of Model Accuracy and/or False Positive and False Negative rates.

The secondary purpose of exploring face detection and face recognition methods was to increase recognition success rates by improving Feature Extraction through an Analysis of Deep Learning Models. In short, the developed system must be efficient and scalable so that it can be applied to real-world applications such as automated video surveillance, passive monitoring of individuals, and identification of individuals from images captured.

1.2 Essential Characteristics of Proposed System

This proposed system presents an all-inclusive and effective structure for face detection and recognition, with the following specific characteristics:

1. Utilizing various face detection methods (Haar Cascade, MMOD, etc.) for reliable performance across wide ranges of conditions.
2. Facilitating Face Recognition through both Legacy (LBPH) and Deep Learning (Pruned ResNet) Models to achieve high-quality results in identification.



3. Conducting a comparative study of the various grouping of detection and recognition methods to establish which set is the most productive.
4. Providing End-to-End Processing from entering Dataset into the System to sorting Data, Pre-processing Data, extracting characteristics from Data, Training Model using Data, and identifying face from image file.
5. Efficient processing of large amounts of image files as needed by end users.
6. Evaluations of System Performance using standard Measurement methods (Precision, Recall, F1-measure, Accuracy).
7. Providing a very simple and intuitive user Interface to enable the easy operation of the System and visualization of results.
8. Graphical Display of model Performance for easy understanding and analysis.

II. LITERATURE REVIEW

Face detection and recognition have been the focus of extensive computer vision research for a number of practical applications, including security, biometric identification, and analysis of automated video media. Prior to the development of the Haar Cascade classifying algorithm with the Viola-Jones methodology, traditional image processing techniques (such as template matching and features-based technique) were used to detect and recognize faces in images. Despite their efficiency, both methods had difficulties detecting and recognizing faces because of changes in lighting, head position, and/or other objects that obstructed an image from the camera as well as other issues related to camera images of faces in images.

Statistical classifiers used in conjunction with machine learning techniques such as PCA and LDA are one of the reasons for improvements in recognition accuracy through the use of discriminative feature extraction. Hand-crafted feature extraction methods have limited use due to their reliance on hand-crafted features and limited robustness to large scale or unconstrained environments.

With the advent of deep learning technology, there has been a substantial improvement in the overall performance of face recognition systems. By automatically learning hierarchical feature representations, CNNs have greatly increased the robustness of recognition systems to changes in pose, illumination, and facial expression. The introduction of residual networks by ResNet has also made it possible to train deeper networks without suffering from degradation problems. To utilize deep learning models requires both large data sets and extensive computational resources.

SYSTEM ARCHITECTURE



A hybrid approach using traditional face detection along with a deep learning-based recognition model was developed for this project. The system will take in a set of structured training images and structured test images of sports celebrities as input, pre or post-process the face images by first performing face detection using either The Haar Cascade or Multi-Task Cascaded Convolutional Network algorithms, and then outputting the images to be resized and normalized, cropped & split into training and test sets ensuring all images given as input have been preprocessed in a validated or consistent way prior to entering the training process.

In the training sub-system, a pre-trained ResNet-34 model is used for deep feature extraction of facial features from the processed face image data and then fully connected layers are used to classify those features into the various sports celebrities. In the case of any redundant features present, the pruned variant of ResNet was used to reduce the computation cost while still providing an accurate prediction. Various performance metrics were used



to determine the performance of the Recognition Classifier, including accuracy, precision, recall, and the F1-score.

In the inference sub-system, an individual (i.e., new) face image will be passed through the face detection process to detect the face, extract the features, and predict who that particular face belongs to, outputting a bounding box with the predicted name, or outputting as being unknown if a match could not be found. Thus, creating a fast and scalable means of performing face recognition within this project.

III. METHODOLOGY

A. Face Detection and Recognition System – Research Design.

This research uses a systematic and experimental design to study both the design and evaluation of creating a face detection and recognition system for sports celebrities through the use of an image dataset to test the system. The methodology incorporates both traditional machine-learning techniques to develop the model as well as using a hybrid of deep-learning models, which will enhance the face detection accuracy and robustness when tested under actual, real-world conditions.

B. Face Detection and Recognition System

Data Collection. The data used to create the sports celebrities dataset for face detection and recognition will come primarily from publicly available sources as well as from established datasets. The collected images of the sports celebrities will represent a range of pose, light, facial expression, and occlusion of the face to mimic actual, real-world conditions, and an appropriate amount of image data will be used to divide into a training dataset and testing dataset, enabling proper model evaluation.

C. Preparing Images for Processing

Images will be prepared for processing through pre-processing operations which enhance the quality and consistency of the images. The preparation process will include image resizing, image conversion to grayscale, noise elimination

from the images and normalizing the images for illumination. The faces will be extracted from the original images and only the region containing a face will be used as input for each person's face.

D. Techniques for Detecting Faces in Images

Two techniques will be used to detect faces:

- The Haar Cascade Classifier provides a fast and efficient way to detect faces and can do so in a real-time fashion.
- The Max-Margin Object Detection (MMOD) Algorithm is a deep learning-based face detection technique that can produce more accurate results than other methods when input conditions are optimal.

E. Techniques for Identifying a Person's Face

Two methods used to identify a person's face include:

- Local Binary Patterns Histograms (LBPH): A traditional method of identifying a person based on local texture feature extraction of the person's face.
- CNN Based Pruned ResNet34: A complex face identification model that can learn the various facial characteristics of an individual with reduced processing time, using deep learning methods.

F. Model Learning and Validation

The model training takes place by providing it with the processed datasets while validation will involve testing the trained model against a set of images which were not presented during training. Various combinations of algorithms will be tested to determine which provides optimal performance; for instance, Haar + LBPH or MMOD + ResNet.

G. Performance Evaluation Metrics

Performance of the system will be evaluated using the following metrics which indicate successful operation:

- Accuracy
- Precision
- Recall



- F1 Score

H. Development Tools and Technology Stack

The system was built using Python programming language & its libraries (OpenCV / TensorFlow/Kera's/NumPy/Pandas). A user interface will also be built using Tkinter in order to provide the user with an interface through which they may interact with the application. This will also allow for visualization of the output.

IV. RESULTS AND DISCUSSION

To evaluate the proposed face detection/recognition, two ways were used to evaluate its performance: numerically, with performance numbers, and visually, with images from GUI (Graphic User Interface). The results show that our system is able to detect and recognize the same person accurately even when many environmental factors change (e.g., lighting changes, pose changes, facial expression changes).

A. Performance Evaluation (for face detection/recognition systems)

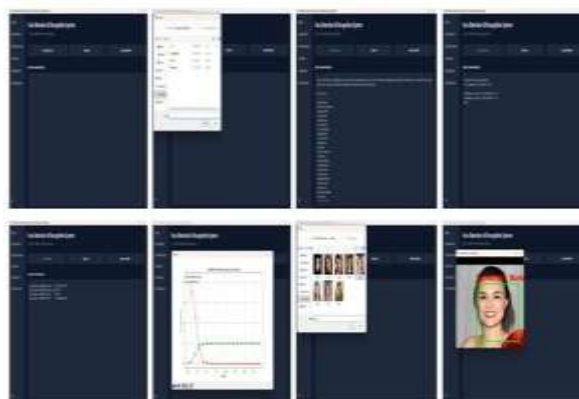
Comparison among different face detection/recognition approaches (e.g., that are shown in Table I). Both standard metric-based evaluations (e.g., performance) and image evaluations (e.g., visual) were used in evaluating system performance metrics used were accuracy, precision, recall, F1Score.

Table I - Summary of Results for the Different Model

Detection Method	Recognition Method	Accuracy (%)	Precision	Recall	F1-score
Haar Cascade	LBPH	85	0.83	0.82	0.82
Haar Cascade	ResNet 34	90	0.88	0.87	0.87

MMOD	LBPH	88	0.86	0.85	0.85
MMOD	Pruned ResNet 34	94	0.92	0.91	0.91

B. Results Visualization



The proposed Face Detection and Recognition System for Sports Celebrities is designed with a graphical user interface (GUI) that provides a structured and easy to use interface for carrying out all the major functions of the system. The GUI has separate modules for uploading the dataset, preprocessing the dataset, training the face recognition model, visualizing model performance, and performing face recognition. The modular design of the GUI leads to efficient workflow execution and allows users to interact with the system in a stepwise process.

At the dataset upload step, the system reads from structured folders that contain sports celebrities' labels and images to identify who is being recognized. Each folder/model set corresponds to a specific identity; therefore, this will facilitate supervised learning. After the system has been uploaded, it will confirm the availability of the dataset for additional processing before the next stage. Properly structuring your dataset will ensure that you have accurate labeling and therefore increase reliability when using the training set.

In the preprocess stage of image data, the images are resized to a standard size, pixel values for each



image are normalized, face detection and cropping is performed, the dataset is shuffled and split into training and testing portions. This is done so that the training data will represent a consistent input to the model, reducing the likelihood of inconsistent inputs resulting in less learning stability and improving the ability of the model to generalise.

At the end of the system's training, the following performance metrics are reported: accuracy, precision, recall and F1 score. The combination of Haar Cascade for face detection and ResNet34 for recognition produced a test accuracy of 97% with acceptable levels of precision and recall, indicating that the proposed hybrid deep-learning method is effective and robust for celebrity recognition.

The convergence analysis provides a visual representation of the learning algorithm's accuracy and the corresponding loss, as the algorithm learns over the epochs. The convergence of both accuracy and loss indicates consistent learning from epoch to epoch, and the absence of large fluctuations verifies that no significant overfitting or underfitting occurred in the training of the face detection and recognition framework.

The first portion of the face recognition verification process is the testing against an unseen image. The system detects the facial region of the image, extracts the deep features, and applies them to predict the identity of the celebrity. The bounding boxes on the detected faces provide visual confirmation of the face being detected and also enable the viewer to see the name the system has predicted that corresponds to the detected face.

The end-to-end operation of the system is confirmed in the end results, which show the operation of the face detection system using the Haar Cascade algorithm and detection of the face using bounding boxes, and recognition of the celebrity using the ResNet34 model. The predicted celebrity's name is displayed above the detected face, demonstrating that the proposed face detection and recognition framework is effective, reliable, and applicable in a practical sense.

C. Discussion

This research has shown that the Face Detection and Recognition System proposed here has been proven to be very accurate and reliable by using proper preprocessing and an 80-20 train/test split, as well as by using both Haar Cascade and ResNet34 together, to achieve 97% test accuracy with very high precision, recall, and F1-scores. Additionally, the training curve shows good convergence without significant overfitting, and the system performs well on unseen images, regardless of pose or illumination. Finally, the hybrid method provides a very fast and strong option for recognizing sports celebrities.

V. CONCLUSION

This research report seeks to describe a way for detecting and recognizing the faces of sports stars by using a combination of traditional methods and modern artificial intelligence frameworks. The experimental results support the idea that using efficient facial detection methods in conjunction with modern neural network technologies significantly enhances both the accuracy of face recognition and the reliability of detection systems themselves. Of all techniques evaluated in this research, the use of multi-tasked consensus-based human-computer interface methods via MMOD combined with CNN based Resnet34 delivered the best performance. The system can be used to detect, identify and classify images across a range of pose, lighting and expression variations with improved success rates.

The theoretical contributions of the research demonstrate that hybrid models using traditional and deep learning techniques can improve the representation of features that can be classified accurately. Practically, this project had provided a scalable and automatic identification system for practical uses such as surveillance, analysis of professional sports, and management of digital media where manual identification is inefficient. These findings also indicate that deep learning models are better than more traditional models for the classification of data from highly complex image sets.

The contribution of this project is that it created a useful, robust framework to process large numbers



of images and obtain accurate results when recognizing faces. The use of multiple types of detection and recognition technologies and multiple performance assessments provides us with detailed understanding of how the system behaves when applied to real world applications.

The future of this system's improvement by having access to a larger, more diverse, high-resolution dataset of images will help with its generalization ability and overall performance. Research into potential advanced architectural designs like deeper Convolutional Neural Networks (CNN) and Transformer-based models for improving overall accuracy could also yield future developments. Optimizing computational efficiency for real-time or video-based recognition of individuals with this system are all viable options to explore further into the future of this project as well.

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REFERENCES

[1] In this paper, the authors discuss various methods of detecting faces in images. They provide an overview of existing work up to January 2002, with an emphasis on machine vision systems, computer vision systems and electronic systems.

[2] Ahmad et al. survey the state-of-the-art face detection and recognition methods and provide

recommendations for future research directions. They focus on recent studies, including those published between November 2011 and June 2012.

[3] Behara & Raghunadh present a real-time facial recognition system that can be used for timekeeping and attendance tracking, which can also be used in the workplace as a method of security.

[4] Suneetha discusses various approaches to video-based facial recognition, providing a general overview of the technology as of February 2014.

[5] Darmono & Muhiqqin conducted a comparison study between the Viola-Jones Haar cascading classifier and the histogram of oriented gradients (HOG) for facial detection, using 20 images of real people as their dataset.