Analysis of Machine Learning Algorithms for Face Recognition in IoT Applications

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Abstract: Nowadays face recognition has been widely used in security and human-machine interaction systems. It is as yet challenging for computer system to naturally recognize or verify an individual because of huge variations such as illumination, pose and facial expression. We perform the analysis of different machine learning algorithms for face recognition. With this analysis results we try to identify the appropriate machine learning algorithm for Internet of Things (IoT) applications. Finally we review the recent progress of deep learning in video face recognition. We propose a deep learning algorithm for face recognition in crowed with multiple subjects in each video for IoT applications.

IndexTerms **- face recognition, machine learning, IoT, deep learning, big data, security.**

I. INTRODUCTION

These days it has turned out to be serious issue in the security of society. Face recognition (FR) has been the conspicuous biometric procedure for character confirmation and has been broadly utilized in numerous regions, for example, military, account, open security and day by day life. FR has been a long-standing exploration point in the CVPR people group. This security framework is a blend of face acknowledgment framework and IoT. These two innovations are developing advances and with the assistance of them, much headway should be possible. There are many face recognition calculations created till date however none of them are appropriate and consequently everyone has its detriments. Subsequently later on a legitimate structuring in the face acknowledgment calculation should be possible and another calculation can be presented [6][7][8].

The innovation is versatile along these lines new alterations can be effectively done. New equipment can be effectively joined subsequently new brilliant home idea can be executed. Everything in that home will be savvy. That implies we don't have to offer order to equipment types unfailingly. Equipment itself will know do's and don'ts. We attempt to build up an appropriate AI calculation for face acknowledgment in IoT applications: brilliant city. We will likewise build up another face acknowledgment calculation which will assume control over the drawbacks of calculations like PCA (***Principle Component Analysis***) and LDA (Linear Discriminant Analysis).

In this paper, we have assess the ongoing advancement of deep learning in face recognition in video. The deep models have essentially improved the exhibition in these zones, frequently moving toward human abilities. The purposes behind this achievement are two-collapsed. To start with, huge preparing information is ending up progressively accessible (for example information streams from a huge number of keen city sensors) for structure up enormous profound neural systems. Second, new propelled equipment (for example GPU) possesses to a great extent diminished the preparation energy for deep systems. We accept that deep learning will have an increasingly imminent future in a wide scope of uses. Deep learning can use huge information for preparing profound engineering models in order to acquire all the more dominant highlights for speaking to faces. In future, face recognition frameworks in savvy urban communities will to a great extent depend on various leveled highlights gained from deep models. The latest application of ML is in the area of IoT. IoT is the interconnection of devices with the sole aim of sharing information. A combination of ML and IoT has been employed in cyber security systems for intrusion detection using a data mining approach [13][14][15]. The face recognition is a subject of machine learning and pattern recognition. That is frequently used for various different applications for authentication and secure access control due to their uniqueness.

II. RELATED WORK

The previous works related to our work in the field of face recognition, machine learning and IoT are reviewed.

In paper [1] the authors have proposed a face recognition using Eigen faces and PCA. From the analysis of this work we identified the solutions for dimensionality problems for face recognition. This approach is quite robust in the treatment of face images with varied facial expressions as well as the directions. However, the disadvantage of this approach is it is very sensitive to images with uncontrolled illumination conditions.

In paper [2][3] the authors have proposed a face recognition using LDA. From the analysis of this work we identified the face recognition is carried out based on linear projection from the image space to low dimensional space. But the major disadvantage of applying LDA is that it may encounter the small sample size problem.

In paper [4] the authors have proposed a video face recognition using deep learning based feature extraction. From the analysis of this work we identified that the proposed algorithm yields verification accuracy of over 97% at 1% false accept rate whereas, on the YouTube Faces database, over 95% verification accuracy is observed at equal error rate. But this work is not useful for face recognition in crowed with multiple subjects in each video [4].

In paper [4] the authors have perform survey on deep learning algorithms with application to video analytics for a smart city. From the analysis of this work we identified that the deep models have significantly improved the performance in face recognition areas, often approaching human capabilities. We believe that deep learning will have a more prospective future in a wide range of applications.

From the above review we identified that none of the previous work deals with the efficient algorithms or system for face recognition in IoT applications. There are no suitable algorithms or system for IoT applications. Further we try to identify a suitable algorithm and extend this work for improvement in IoT applications: smart city.

III. ANALYSIS OF MACHINE LEARNING ALGORITHMS FOR IOT APPLICATION

i. Principle Component Analysis (PCA) Algorithm

This algorithm undergoes two steps for recognition of face: first step is feature extraction using Principle Component Analysis and second step is recognition using the feed forward back propagation Neural Network. The Eigenface approach uses Principal Component Analysis (PCA) algorithm for the recognition of the images. PCA based IoT system is used for smart city to perform public monitoring and detection and minimization of faults.

Advantages: PCA can attain dimensionality reduction and as a result reduce the complexity of the model. The methodology utilizing Eigenfaces and PCA is very strong in the treatment of face pictures with fluctuated outward appearances just as the bearings. Be that as it may, this methodology is touchy to pictures with uncontrolled light conditions. In this assessment, we utilized the eigenfaces to speak to the feature vectors for human countenances. The features are extricated from the first picture to speaks to one of a kind personality utilized as contributions to the neural system to gauge comparability in grouping and acknowledgment. The eigenfaces has demonstrated the capacity to give the critical highlights and decreases the info size for neural system. In this manner, the system speed for recognition is raise.

Disadvantages: PCA is an feature-reduction strategy that ought to be utilized with other ML techniques to set up a compelling security approach.

Potential applications in IoT security: PCA can be utilized for real-time detection systems in IoT environments by reducing the model features. PCA is used for smart data analytics: the data processing task is feature extraction.

ii. Linear Discriminant Analysis (LDA) algorithm

Linear Discriminant Analysis (LDA) has been effectively connected to face recognition which depends on a straight projection from the picture space to a low dimensional space by augmenting the between class dissipate and limiting the inside class disperse. LDA permits target assessment of the essentialness of visual data in various highlights of the face for recognizing the human face. The LDA additionally furnishes us with a little arrangement of highlights that convey the most important data for characterization purposes. LDA strategy conquers the constraint of Principle Component Analysis technique by applying the linear discriminant model. The Linear Discriminant Analysis technique is used for the feature extraction. LDA is also known as linear transformation method and it is similar to PCA method except that LDA absolutely also finds within and outside class differences. i.e. it is a supervised method. LDA is most frequently used as dimensionality reduction method in the pre-processing step for pattern classification and, machine learning applications.

iii. Deep learning algorithm for video face recognition

For performance study/analysis, we simulate the deep learning algorithm for video face recognition using MATLAB. We propose the simulation of algorithm for video face recognition in YouTube and PaSC(point and shoot challenge) databases obtained using Android Mobile Phone. This algorithm utilizes frame selection and deep learning based feature representation. The algorithm follows three steps for video face recognition: Entropy based frame selection, Feature extraction using deep learning framework and Face verification using Feature Richness and Deep Learning Based Representation [4]. The steps carried out for face recognition from video is shown in figure 1. Advantages of proposed work

1. Performance Improvement of proposed algorithm
2. The frame selection based on feature richness offers noticeable and consistent improvement in performance as compared with frontal only frames, random frames, or frame selection using perceptual no-reference image quality measures and
3. Face verification performance can be improved with the use of Joint feature learning in SDAE and sparse and low rank regularization in DBM.
4. The algorithm yields the verification accuracy of over 95% to 97%

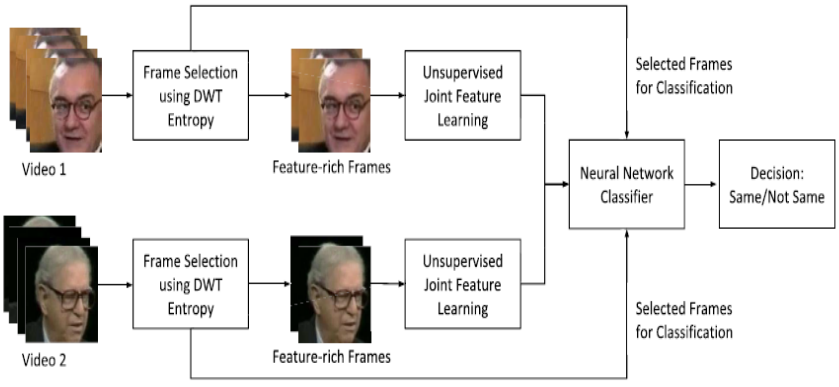

Figure 1. Illustrating the steps involved in the face recognition using deep learning algorithm [4].

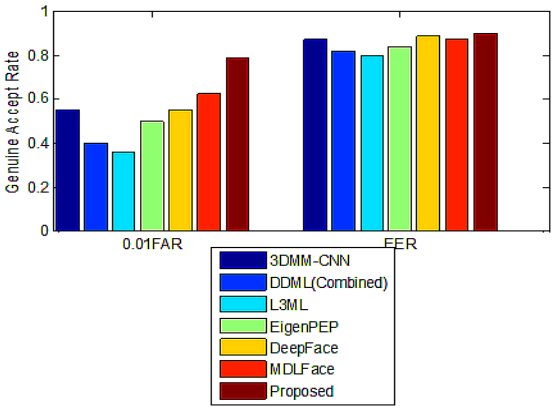

Figure 2 summarizing the verification performance of the deep learning algorithm and state-of-the-art algorithms on the YouTube Faces database.

From the above figure 2 analysis of simulated results we see that the deep learning algorithm is suitable to video face recognition in IoT applications. Further we will carry out the research on Deep learning algorithm for face recognition in crowed with multiple subjects in each video for IoT applications. We will try to use the deep learning algorithm for IoT based smart city application and also IoT big data analytic. Deep learning algorithms can be applied to video analytics of smart city for face recognition.

IV. Deep learning for Internet of Things(IoT)Application

Deep face recognition frameworks are currently accepted to outperform human execution in many situations [5]. There are likewise some intriguing endeavors to apply profound models to help human administrators for face check [9][10]. In spite of this advancement, numerous essential inquiries are as yet open, for example, what is the "personality limit" of a profound portrayal? Why deep neural systems, as opposed to people, are effectively tricked by antagonistic examples? More profound comprehension on these inquiries may assist us with building hearty applications in genuine world. The security framework, proposed, is minimal effort, low power devouring framework. This framework can without much of a stretch give abnormal state of security as it consolidates two present day advancements together for example face recognition and IoT. These are quickly developing advances in businesses and researchers are as yet examining on them[12]. In this manner these two have had a critical effect on security framework advancement. Due to these, the security will practically twofold. Remote controlling and checking is conceivable due to utilizing IoT and Face recognition has made it practically difficult to hack.

Deep learning has recently reached very promising outcome in the areas of computer vision, speech recognition and natural language processing. It aims to learn hierarchical representations of data by using deep architecture models. In a smart city, a lot of data (videos captured from many sensors) has to be processed and analyze automatically. Deep learning algorithms can be applied to video analytics of smart city for object detection, object tracking, face recognition, image classification and scene labeling

Object detection has a wide range of smart city applications, such as pedestrian detection, on-road vehicle detection, unattended object detection. Deep learning algorithms are capable to handle large variations of different objects. As a result, the smart city systems using deep models are more robust to large-scale real data.

Object tracking is intended to locate a target object in a video sequence given its location in the first frame. Recently, some deep learning based tracking algorithms have achieved very promising results.

Object tracking can be applied to surveillance systems of smart cities. It is important to automatically track suspected people or target vehicles for safety monitoring and urban flow management. Deep learning can leverage smart city big data to train deep models which are more robust to visual variations of target objects than traditional models. Therefore, smart city tracking systems can be enhanced by using deep learning algorithms for handling large amount of video data. Also the, deep learning has achieved very promising results in image classification and scene labeling.

Consistent with the smart data characteristics, analytic algorithms must be able to hold Big Data[11], that is, IoT requires algorithms to analyze data coming from a variety of sources in real time. Several attempts are made to 835 addresses this issue. For example, deep learning algorithms, revolutionized form of neural networks can achieve high accuracy rate if they have sufficient data and time. Deep learning algorithms can be easily intended inuenced by the smart noisy data, furthermore, neural network (NN) based algorithms lack interpretation, this is, data scientists cannot understand the reasons for the model results. In the same 840 manner, semi-supervised algorithms which model the small amount of labeled data with a large amount of unlabeled data can assist IoT data analytics as well. Feed forward neural network is one of the class of machine learning algorithms used for smart data analytics: the data processing task are Regression/Classification/ Clustering/Feature extraction. Feed Forward Neural Network for IoT based smart health and to have benefits like Reducing Energy Consumption, Forecast the States of Elements; Overcome the Redundant Data and Information[13][14][15].

V. Conclusion

We have successfully carried out the analysis of different machine learning algorithms for face recognition. Also we have identified a appropriate machine learning algorithm for Internet of Things (IoT) applications. Finally, we have reviewed the recent progress of deep learning in face recognition from video and we have proposed this algorithm for IoT applications.

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