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RESEARCH ARTICLE

MACHINE LEARNING ALGORITHMS IN FACIAL IDENTITY VERIFICATION FOR COMPUTER-BASED ASSESSMENTS

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ABSTRACT

This review paper analyses the utilization of machine learning algorithm in facial identity verification of computer-based assessments. Through the use of facial recognition, this project aims to increase security by letting a customer know who is actually using the system. Only authorized customers are able to enter the framework. Neural learning approaches for face recognition can be used for feature extraction and training modules. Furthermore, a lot of people use similar methods to extract information from photographs of people. Certain detection systems can perform full body scans, as well as iris and finger print recognition. The purpose of these systems' deployment is safety and security. In this study, we examine many facial recognitions machine learning techniques. Four supervised machine-learning classifiers for face recognition are taken into consideration: Support Vector Machine (SVM), 1-nearest neighbor (1-NN), Principal Component Analysis (PCA), and Linear Discriminant Analysis (LDA). The accuracy with which different categorization schemes can recognize a face is another way in which their efficacy is proven and evaluated. The process of identifying faces of individuals whose photos are kept in databases and made available as datasets is known as face recognition. Numerous tests carried out using these datasets. Which machine learning method is the best in terms of picture detection accuracy is made evident by the comparative study. Even if there are other very successful identification techniques, face recognition has remained a prominent area of study interest because it is a simple and non-intrusive way for people to identify themselves. The results of this study could be helpful in determining the best machine-learning method to improve the accuracy of facial recognition.

KEYWORDS

facial recognition, deployment, framework, machine-learning

1. INTRODUCTION

Experiencing a wide range of applications, machine learning is one of the computer science fields with the quickest growth. It speaks about the automatic identification of significant patterns in data (Ullmann, 2019). The venture's machine learning-based facial recognition system for computer-based assessment is presented in this section. Artificial Intelligence (AI) is its essential component. Computerized reasoning is concerned with the architecture of machines with human-centered capacitye (Yadav et al., 2022)

Artificial intelligence (AI) techniques are used in the Machine Learning Based Facial Recognition System for computer-based assessment project to recognize and identify approved and disapproved clients these are the two categories of clients that exist here. Throughout the preparatory process, the customer stays in front of the camera, which captures various images of them (Mahesh, 2020). The captured images go via a facial recognition algorithm. Through this process, faces in the photos are identified. Preprocessing is applied to the detected faces in order to reduce the dataset. The experience with preprocessed images emphasizes the extraction procedure, which is used to eliminate face features. Then, these facial features are hidden within the frame work (Mahesh, 2020).

In a face identification system, a researcher put any random picture as a query in the database then it finds the peoples identification with respect to that random image (Oloyede et al., 2020). The human facial image shows a complicated, meaningful and multidimensional, visual analeptic. Developing a computational model to recognize facial recognition is very difficult. It is complex of face detection because of many (Adedeji and Oyekanmi, 2018) .

During the testing stage, processes including face identification, preprocessing, and include extraction take place. Then, characterization is applied to the eliminated facial highlights. the process of classifying data into predetermined groups (Taskiran et al., 2020). The face is identified as an approved or unapproved customer after the deal. Should the customer be authorized, they will be granted access to the framework. The remote assistant's services would thereafter be advantageous to the client. The virtual assistant provides services such as retrieving information from Wikipedia (Iyer et al., 2020). If a customer is not approved, they are encouraged to register with the administrator. Taking photos of the customer while the administrator is watching is part of the registration process (Ullmann, 2019).

The facial recognition system addresses the problem of identifying or verifying that there is at least one person(s) who are enthusiastic about a scene by comparing informational faces with stored face images in a database (Taskiran et al., 2020). Although faces can be perceived quickly and accurately in some situations or after a significant amount of time has passed, the human mind is limited in how many persons it can accurately "recall." A PC framework's benefit would be its capacity to handle sizable informative quantities of facial image data (Thanathamathee et al., 2023). The task is quite taxing, even if it is somewhat easier in a controlled environment with frontal and profile images of people's faces accessible (with a consistent base and indistinguishable attitudes among the participants. Face recognition systems might involve multiple stages, such as image identification, detection, and feature extraction (Taskiran et al., 2020). In addition to these, picture border detection, location, and analysis

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that is, obtaining the pre-processed surplus face image from a query, regardless of how simple or complex the query is—as well as image dissolution are other features of recognition (Padmakar and Murthy, 2021).

The ultimate result of the provided facial image is referred to as face recognition. In face identification systems, evaluating the algorithms is evident (Ullmann, 2019). A group researcher further revealed that evaluation provides insight into the systems and recognition algorithms that have already been used (Du et al., 2022). While analyzing the effectiveness of machine learning algorithms for face recognition (LDA, 1-NN, PCA, and SVM), the work aims to improve accuracy (Faridi et al., 2021). The results of this study could be helpful in determining the best machine learning method to improve facial recognition accuracy. This work is divided into the subsequent sections.

Conventional design acknowledgment problems, like character acknowledgment, typically have fewer than fifty classes and a vast number of practice exams available for each class (Zhang et al., 2023). In contrast, a relatively small number of face images are available for training in face recognition, despite the fact that there are a vast number of potential face classes (Kortli et al., 2020). Because of this, a robust and efficient computation is needed for a machine recognition system to identify a human face from a still or moving image of a scene and accurately recall it by associating it with the appropriate person, for example by using a stored database of face image (AbdELminaam et al., 2020).

2. Literature Review

In the past, the researchers have developed several algorithms and strategies for facial recognition. These are discussed in the section below (Padmakar and Murthy, 2021).

2.1 Independent Component Analysis Based on Face Recognition

Face popularity algorithms typically rely on unsigned, non-surveyed statistical methods to determine face representation (Faridi et al., 2021). These techniques use a mixture of linear snap photos to identify faces and create a consistent base image. Principal component analysis (PCA) is a common technique for analyzing the core issue, it relies heavily on pairwise correlations in the pixel database for its foundation pictures (Huang et al., 2020). When storing vital records in high-order pixel connections, face believability is also important. Foundation photos should be evaluated using procedures that consider excessive order statistics. One approach is independent aspect assessment (ICA), which is a generalization of PCA (Afzal et al., 2021).

2.2 Eigenspaces

One of the most effective techniques for the computational identification of faces in digital pixels is undoubtedly an Eigenspace, which is mostly based on facial recognition (Peng et al., 2021). Saha and Pradhan asserted that several Eigen space-based face recognition techniques have been presented, starting with the Eigen face Algorithm (Saha and Pradhan, 2018). The purpose of the research project is to present an impartial comparison of some of the main Eigen space-based approaches. Research groups that have projected each approach typically employ their operations to accomplish comparisons, which no longer account for equal operating conditions for the algorithms (Khan et al., 2019). For this reason, it's believed that conducting unbiased investigations is important. Often, a completeness of the research organizations' capabilities rather than an assessment of techniques is accomplished.

2.3 Elastic Bunch Graph Matching (EBGM)

EBGM is a popular proposed approach of face recognition. We offer a broad variety of flexible group graph matching in this painting, as well as its current modifications in landmark model matching (Taskiran et al., 2020). This work evaluated the aforementioned methodologies and experiments using data from the FREET database. The researchers discovered that flexible group graph matching strategies can enhance and demonstrate the usefulness of facial graphs using particle swarm optimization. The Gabor wavelets, which use excavation to locate landmarks, provide as the primary foundation for the landmark model matching (Faridi et al., 2021). It was demonstrated that integrating the gray surface pro lace can lead to improvement. Furthermore, principal components analysis was used to take use of the well-known expenses associated with combining Gabor Violet's hybridizing resources with Egan facial functions, which can yield all the information pertaining to facial appearance (Mahesh, 2020).

2.4 Face Recognition Approaches

For facial credibility issues, photometric analysis which provides a complete image of a face and geometric analysis which is feature-based—are the two key methods. As long as the researcher is passionate about facial recognition. Face recognition algorithms have been created in a very good way. According to a study, there are two main categories for these identifying techniques (Singh and Goel, 2020).

2.5 Geometric

Its entire foundation is the geometric court that exists between facial features, or more accurately, the dimensional arrangements surrounding facial features. This allows for the placement of facial predictions, such as the mouth, nose, and eyes, first, and the labeling of the face with geographic angles and distances (License et al., 2023).

2.6 Photometric Stereo

Excellent lighting fixtures are used to enhance a product's appearance from some of the photos taken in the given circumstances. A gradient is used to represent the recovered item's form. We made advantage of the UK's Olivetti Research Laboratory's open set data set. The dataset consists of 40 folders with ten distinct image types (License et al., 2023).

2.7 Face Detection and Feature Extraction

2.7.1 Face Detection

One important part of a generic programmed face acknowledgment framework's preprocessing stage is identifying and tracking face-like objects in disorganized settings (Adedeji and Oyekanmi, 2018). before acknowledgment, the face location should be separated from a still image or a video, as most face acknowledgment algorithms assume that the face region is known. The method used to offer a face acknowledgment calculation depends on how well one manages the area where appearances are recorded (Jyothi and Shanmugasundaram, 2021; Yadav et al., 2022). Due to a somewhat consistent basis, division is reasonably simple for applications such as mug shot coordination. It is possible to divide a moving person into groups for a video collected by a reconnaissance camera by using their movement as a signal. While shade-based techniques may have trouble identifying faces in intricate backgrounds and in different lighting situations, shading data also provides a useful key to confront identification (Faridi et al., 2021).

Facial identification is a two-class (facial versus non-face) grouping problem that can be understood as a singular case of face acknowledgment. Certain face recognition techniques may be useful for distinguishing faces, but they are computationally demanding and unable to handle the wide range of variations in face images. Conventional methods for face location include appearance-based tactics, format coordination, and information-based procedures that emphasize invariant draws close (Padmakar and Murthy, 2021). Human information is encoded using knowledge-based algorithms to identify the relationships between face highlights. When the posture, perspective, or lighting circumstances change, highlight invariant approaches identify the fundamental highlights that remain constant throughout the event (Saveski et al., 2021). For face limitation, both information-based and include invariant techniques are used. A few common face examples are tucked away in layout coordinating tactics to depict the face as a whole or the facial highlights separately. Identification is done by processing the associations between an information picture and the stored examples (Jyothi and Shanmugasundaram, 2021).

Additionally, the layouts are allowed to flip, scale, and decipher. In order to detect agent fluctuations in facial appearances, appearance-based approaches acquire familiar with the models (or layouts) viaseveral preparatory photographs (Jyothi and Shanmugasundaram, 2021). This category of methods covers several artificial intelligence computations (e.g., neural networks, support vector machines, and so on) that identify frontal and upright facial views in low-resolution images (Kortli et al., 2020). There seems to be a more rational incentive for the explanatory methodologies—which consider the spatial space to consider extraction rather than the all-encompassing tactics. Explicit face highlights are stored in a database and physically or organically divided by an image preparation framework in these methods (Padmakar and Murthy, 2021). The next step is to get applications from the database using a hunt method.

2.7.2 Feature Extraction for Face Recognition

Highlight coordination via a database using proximity or separation metrics is part of face acknowledgment (Huang et al., 2022). The method compares an information image to a database and reports a match. There are two broad categories into which facial recognition techniques now in use can be categorized: explanatory and comprehensive approaches (Miao et al., 2019). Several geometrical highlights from the face, such as the eyes, nose, and mouth, can be extracted using the investigative or highlight based methodologies, which concentrate on analyzing the spatial space (Izhar et al., 2023).

The global characteristics of the human face design are taken into account by the appearance-based or all-encompassing techniques (Fuentes-Hurtado et al., 2019). Without using specific fiduciary focuses obtained from different facial districts, the face is viewed as a whole. The majority of the time, comprehensive techniques accurately depict faces in pixel force clusters without identifying facial highlights (Ali et al., 2021). Compared to geometric element-based procedures, this class of solutions is typically more intuitive and easier to implement because it does not involve the recognition of geometric face highlights (Faridi et al., 2021).

A combination of comprehensive and explanatory methods has also been tried. For example, combined 16-point highlights with the regions of the mouth, nose, and eye (Izhar et al., 2023). They demonstrated success in recognizing the appearances at different points of view by using a database that included 40 frontal-see faces. There were two steps to the strategy. First, a diagnostic technique was applied to identify 15 facial emphasis points: the mouth corners, the eyebrows, the nose, the eye corners, and the face limit Using a head model and geometrical estimates, the turn of the face was assessed (Garg et al., 2020). The component focuses were positioned so as to approximate their corresponding positions in the frontal view.

Then, a comparison was made between these element focuses and the faces in a database. In the next step, only similar faces from the database were taken into account. The eyes, nose, and mouth windows were compared with the database by connection in the next advancement (Izhar et al., 2023). A comprehensive face acknowledgment framework was created by combining the two elements. This methodology yielded a high recognition rate for different points of view.

3. Face Recognition Algorithms

Many previous face recognition computations rely on include-based techniques that identify numerous geometric features on the face, such as the lips, nose, eyes, and eyebrows (Adjabi et al., 2020). Face recognition uses properties and relationships, such as zones, separations, and edges between the component foci, as descriptors (Peng et al., 2021). Typically, each face produces 35–45 element focuses. Face acknowledgment based on geometrical highlights is presented, although it depends on how accurately the element area is calculated. In any case, there are no common answers to the questions of how many focuses produce the best results, what the important highlights are, and how to organically eliminate them (Jyothi and Shanmugasundaram, 2021). Face recognition based on geometric element coordinating works well for face images with modest resolutions (8×6 pixels) where the individual facial features are hardly visible.

This implies that the facial highlights' overall geometrical design is sufficient for recognition. For dimensionality reduction and spotlight extraction, two easily understood instantaneous exchange algorithms that are most frequently used are Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) (Yadav et al., 2022). While PCA seeks to identify a trade that may speak to high dimensional statistics in fewer measurements to the extent that most severe statistics about the records are available in the changed area, LDA seeks to perform dimension decrease while preserving as much of the magnificence prejudicial data as is reasonably expected (Weeraratne et al., 2024). Certain well-known commercial face recognition products, like Eigen face and nearby highlight investigation (LFA), employ face portrayal methods that are derived from the PCA or the Karhunen - Loeve (KL) extension mechanisms (Padmakar and Murthy, 2021b).

Multi space KL is recognized as an additional technique with single dimensionality reduction for facial recognition and design representation (Binol, 2018). May outperform KL in situations where the information flow is far from a multivariate Gaussian. Reparability criteria are not legally diagnosed with the exactness of the arrangement inside the yield space in classical LDA. To lessen the possibility of misdiagnosis, article instructions that are closer together in the yield area are frequently weighted in the data area (Fabiyi et al., 2022). In order to obtain the segregate Eigen highlights, the LDA can be worked at the Eigen face or at the crude face picture (Fuentes-Hurtado et al., 2019). Recently, highlight portrayal solutions that combine the best aspects of several LDA techniques have also been put forth. Part PCA and summarized discriminant analysis (GDA) using a partial technique have proven beneficial for design relapse and arrangement projects (Kortli et al., 2020).

Face acknowledgment based on the free segment investigation (ICA) is being proposed as a theory that is sensitive to higher-request measurements, not second-request connections, due to the possibility that a significant portion of the data may be contained in the high-request connections (Adjabi et al., 2020). Whereas PCA uses eigenvectors to determine which premise vectors capture the biggest picture change, ICA provides a large number of premise vectors with the highest degree of factual freedom (Binol, 2018). Face recognition techniques based on adaptable diagram coordination, neural networks, and support vector machines (SVMs) demonstrated success (Cadena Moreano et al., 2019). Using a combination of layout coordinating and geometrical component coordinating, the line edge map technique extracts lines from a face edge map as highlights. The closest component line classifier looks for the applicant who owns the base separation between the element purpose of inquiry face and the element lines interacting any two-model element focuses in an attempt to increase the range of poses, lighting, and facial expressions that can be covered for a given face class. Facial photo recognition was also considered using a modified Hausdorff separation metric (Taskiran et al., 2020; Yadav et al., 2022).

A brief discussion on the key ideas of a face acknowledgment computation using Eigen face acknowledgment was made, the most widely published methodology, in the attachment. The main task of a face recognition calculation is to identify each person in the test pictures given a large number of face pictures labeled with the individual's personality (the learning set) and an unlabeled arrangement of face pictures from a similar group of people (the test set) (Padmakar and Murthy, 2021). Using the closest neighbor classifier in the picture region may be the simplest acknowledgment scheme. In the mastering set, where separations are envisioned within the photo area, a picture in the test set is seen (ordered) with the help of assigning to it the call of the nearest factor (Ullmann, 2019).

Head segments examination (PCA) is a commonly used approach for dimensionality reduction in PC vision. Eigenface strategy refers to the corresponding calculation regarding confront acknowledgment (Jalaja and Anjaneyulu, 2020). In all honesty, the Eigen face technique uses design diagrams to illustrate the relationships between different components of a framework in order to produce highlights that capture the overall idea of the countenances (Krishna et al., 2022). Several methods are used in machine learning to address data-related issues. Data scientists often emphasize that there isn't just one kind of algorithm that works for every situation. The type of method used relies on the type of problem you want to solve, how many variables there are, what form of model works best for it, and other factors. Here is a brief overview of some of the machine learning (ML) methods that are frequently employed (Osisanwo et al., 2017).

4. Types of Machine Learning Techniques

Machine learning algorithms can be broadly classified into four categories: reinforcement learning, semi-supervised learning, unsupervised learning, and supervised learning (Ayodele, 2012). The following gives a quick overview of each kind of learning strategy and how it might be used to address issues in the real world (Osisanwo et al., 2017).

5. Supervised

Based on sample input-output pairings, machine learning is generally tasked with learning a function that translates an input to an output. To infer a function, it makes use of a set of training examples and labeled training data (Greener et al., 2021). When specific objectives are identified to be achieved from a given set of inputs, supervised learning is implemented, i.e., a task-driven technique (Sarker, 2021). The two most popular supervised tasks are "regression," which functions to fit the data, and "classification," which divides the data. One use of supervised learning is text classification, which is the process of predicting the class label or sentiment of a textual segment, such as a tweet or a product review (Shaheen et al., 2019).

6. Unsupervised

Unsupervised learning is a data-driven method that examines unlabeled datasets without the requirement for human intervention (Tirthyani et al., 2024). This is frequently used for groupings in findings, generative feature extraction, significant trend and structure identification, and experimental purposes. Clustering, density estimation, feature learning, dimensionality reduction, association rule discovery, anomaly detection, and other unsupervised learning tasks are among the most popular ones (Al-Amri et al., 2021).

7. Semi-Supervised

Working with both labeled and unlabeled data, semi-supervised learning is a combination of the supervised and unsupervised approaches described above. It so lies in the middle of "without supervision" and "with supervision" learning (Broeker, 2022). under the actual world, semi-supervised learning is helpful since unlabeled data are common and labeled data may be scarce under various circumstances. A semi-supervised learning model's ultimate objective is to produce a better prediction result than one obtained by the model utilizing just the labeled data (van Engelen and Hoos, 2020).

7.1 Reinforcement

An environment-driven technique, or reinforcement learning, is a kind of machine learning algorithm that allows software agents and computers to automatically assess the best behavior in a given context or environment to increase its efficiency (Sarker, 2021). Some researchers explained that the ultimate objective of this kind of learning, which is reward-or penalty-based, is to use the knowledge gained from environmental activists to take actions that would maximize reward or reduce danger (Szostak and Cohen, 2023). It is not ideal to use it to solve simple or basic problems, but it is a useful tool for training AI models that can help increase automation or optimize the operational efficiency of complex systems like robotics, autonomous driving tasks, manufacturing, and supply chain logistics (Mahesh, 2020). As a result, depending on the goal outcome and the nature of the data that was previously described, different types of machine learning approaches can play a significant role in building effective models in various application areas (Sarkar, 2022).

7.2 Machine Learning Approaches for Face Identification

There are different machine learning approaches are used in face identification.

7.2.1 Feed Forward Neural Network

The most widely used type of deep neural network for facial recognition is the feed forward neural network. A feed forward neural network uses 2D convolutional layers to manage learning characteristics from input data. When manual feature extraction is required, a feed-forward neural network is employed. Thus, the identifying features are what the photos are classified with (Adedeji and Oyekanmi, 2018). A feed forward neural network learns all of the associated characteristics in the networks by directly extracting features from stored images. in a three-layer multi feed forward network with one layer of hidden layer. The bias in the output layer is voi, whereas the bias in the hidden layer is woi. It was discovered that bias exists in both the hidden and output layers of this network. This bias acts as weights on a network, the output of which is always 1 (License et al., 2023).

The network's computational complexity skyrockets when hidden layers are added. For computer vision, digital image processing, and machine learning, the bias works incredibly well. The automatic driving automobile picture issue, which is now employed in machine learning, is the best illustration of a convolution neural network in action. Convolution neural networks are used to process the entire input to be calculated for both the hidden layer and the output (Adedeji and Oyekanmi, 2018).

8. Neural Network with Convolution

One of the greatest methods for pattern recognition networks is the convolution neural network, which uses hidden layers to convert an input image to an output image (Yadav et al., 2022). Convolution neural networks have a long history in computer vision and pattern analysis dating back to Kanihiko Fukushima's neural network architectural proposal for image processing systems in the 1980s. For face detection, the current method could identify geometric patterns in images (Traore et al., 2018).

9. Deep Convolution Neural Network

One or more non-linear processing layers combine with a deep convolution neural network. It is used in machine learning techniques for face detection and recognition on simple faces (Sarker, 2021). The input and output layers of a deep convolution neural network are connected by several hidden layers that serve as communication channels (Traore et al., 2018). Nodes or neurons link these levels together. Following the application of a deep convolution neural network, a set of objects is processed, and the items' matching input photos are automatically recognized. Images with labels from deep convolution neural networks are used as training material in machine learning techniques for facial recognition (Hassan and Mohsin Abdulazeez, 2021). The purpose of a deep convolution neural network is to match corresponding categories after first understanding the attributes of a particular object. Each layer in the deep convolution neural network network contains the information from the levels before it, transforms it, or passes it on to the layer after it (Liu et al., 2023). The objects' intricacy and level of detail are growing thanks to the deep convolution neural network. They are picking up on its pattern elements as they go through the network's tiers.

10. Principal Component Analysis

The most established and widely used method for computer vision, pattern recognition, and digital image processing is principal component analysis. Pearson introduced it, and Hotlling improved It (Greenacre et al., 2022). It was extensively utilized for electrical computers, but it is now deeply ingrained in databases and static computer packages. Reducing the Eigen value and Eigen vectors problem in a matrix is known as principal component analysis (Kherif and Latypova, 2020). To put it simply, a wide range of applications, including digital image processing, computer vision, and pattern recognition, require principal component analysis (Gewers et al., 2021). Principal component analysis's primary goal is to make databases less dimensional i.e. Keeping as much of the variance in the database as feasible while communicating a large number of connected features (Ullmann, 2019).

11. Linear Discriminant Analysis

Fisher discriminant analysis and the linear discriminant analysis approach are connected. Images' local features are described using linear discriminant analysis (Wen et al., 2019). Shape, color, and texture features are terms used to describe the way that the form of pixels in images is extracted (Traore et al., 2018). The linear separating vectors between the pattern's features in the photos are found using the linear discriminant analysis. In order to minimize the intraclass variance in face identification, this approach maximizes the dispersion between classes (Faridi et al., 2021).

12. Face Recognitions Techniques

Face recognition is becoming a more and more common security feature for devices with modest processing capability, such phones and raspberry pies. Many facial recognition techniques are available, including Eigenface, Radon transform (RT), Conventional Neural Networks (CNNs), and Artificial Neural Networks (ANN) (Kortli et al., 2020). The aim of this comparison of the four methods is to determine the accuracy of facial recognition. Using a condensed version of the FERET open set dataset, some researchers carried out an experiment to assess the accuracy of facial recognition using LDA, PCA, SVM, and CNN under the same conditions (Schenkel et al., 2019). The accuracy of these four machine learning methods was determined using Python and the modules cvxopt, sklearn, scipy, and numpy (Faridi et al., 2021).

12.1 Principal Component Analysis (PCA)

Principal element analysis, sometimes known as Karhunen-Loeve expansion, is a valid technique for identifying facial variability that may not be immediately obvious (Padmakar and Murthy, 2021). Principal component analysis, or PCA, would not commit to classifying faces using known geometrical variables such as the width of the supercilium or the length of the anterior naris. Rather, a harsh and brief face has examined the use of PCA to determine that "variables" are responsible for the variation in faces (License et al., 2023).

12.2 Support Vector Machine (SVM)

First heard in 2022, the Support Vector Machine (SVM) was integrated into the COLT-92 by Boozer, Gavin, and Vapnik (Ibrahim et al., 2022). SVMs are a defining task to carry out relevant monitoring to discover classes and regression procedures. SVM is a supervised method that may be used to learn formulations for any category or regression problem (Ghosh et al., 2019). It is, nevertheless, sporadically applied in classification issues. Using this approach, we typically depict each statistic item as a degree in an n-dimensional space (n being the range of your skills), with each performance being represented by the value of a specific coordinate (Greenacre et al., 2022).

12.3 Linear Discriminant Analysis (LDA)

When original data is changed into a very small dimensional space, a maximum linear transformation is detected by linear discrimination analysis (LDA) (Fabiyi et al., 2021). Finding a linear transformation in low-dimensional space that maximizes class separation is the aim of the LDA. LDA extracts $p< n$ new independent variables that most effectively segregate the dependent variable's classes from the dataset's n independent variables (Tharwat et al., 2017).

12.4 The K-Nearest-Neighbors (1-NN)

(k-NN) technique, with k = 1, is simplified in the 1-NN situation. The nearest neighbor's set of rules (k-NN) is a non-parametric method for regression and sophistication in pattern recognition. The k closest training examples inside the feature region are included in each case's entrance. Whether or not k-NN is utilized for regression or classification determines the outcome (Tharwat et al., 2017). For instance, the k-NN is a type of basic study where all counts are halted until the categorization is completed and the function is the one that is regionally nearest (Faridi et al., 2021). Each unlabeled example in the training set is categorized by the k-nearest neighbor method using the majority label among those neighbors (Ghosh et al., 2019). Thus, the distance measure employed to determine its closest neighbors has a critical role in determining its performance (Padmakar and Murthy, 2021).

13. Conclusion

The goal of this research project was to improve the accuracy of machine learning systems for facial recognition. The effectiveness of four machine-learning algorithms was compared. These algorithms include PCA, SVM, LDA, and 1-NN. Both supervised and unsupervised machine learning are possible. Select Supervised Learning if you have fewer data for training that is properly labeled. For big data sets, unsupervised learning typically produces superior performance and outcomes. Use deep learning techniques if you have easy access to large data sets.

References

AbdELminaam, D.S., Almansori, A.M., Taha, M., and Badr, E., 2020. A deep facial recognition system using computational intelligent algorithms. PLoS ONE, 15 (12 December). https://doi.org/10.1371/JOURNAL.PONE.0242269

Adedeji, J.K., and Oyekanmi, M.O., 2018. A Neuron Model of Facial Recognition and Detection of an Authorized Entity Using Machine Learning System. World Academy of Science, Engineering and Technology International Journal of Computer and Information Engineering, 12 (8), Pp. 654–662.

Adjabi, I., Ouahabi, A., Benzaoui, A., and Taleb-Ahmed, A., 2020. Past, Present, and Future of Face Recognition: A Review. Electronics, 9 (8), PP. 1188. https://doi.org/10.3390/ELECTRONICS9081188

Afzal, S., Iqbal, M.M., and Afzal, A., 2021. On the Number of Independent Components: An Adjusted Coefficient of Determination based Approach. Electronic Journal of Applied Statistical Analysis, 14 (1), Pp. 13–26. https://doi.org/10.1285/I20705948V14N1P13

Al-Amri, R., Murugesan, R.K., Man, M., Abdulateef, A.F., Al-Sharafi, M.A., and Alkahtani, A.A., 2021. A Review of Machine Learning and Deep Learning Techniques for Anomaly Detection in IoT Data. Applied Sciences, 11 (12), Pp. 5320. https://doi.org/10.3390/APP11125320

Ali, W., Tian, W., Din, S.U., Iradukunda, D., and Khan, A.A., 2021. Classical and modern face recognition approaches: a complete review. Multimedia Tools and Applications, 80 (3), Pp. 4825–4880. https://doi.org/10.1007/S11042-020-09850-1

Ayodele, T. O., 2012. Atherosclerotic Cardiovascular Disease. Atherosclerotic Cardiovascular Disease. https://doi.org/10.5772/711

Binol, H., 2018. Ensemble Learning Based Multiple Kernel Principal Component Analysis for Dimensionality Reduction and Classification of Hyperspectral Imagery. Mathematical Problems in Engineering, 2018. https://doi.org/10.1155/2018/9632569

Broeker, F., 2022. Semi-supervised categorisation: the role of feedback in human learning. Doctoral Thesis, UCL (University College London).

Cadena, M.J.A., La Serna Palomino, N.B., and Llano Casa, A.C., 2019. Facial recognition techniques using SVM: A comparative analysis. Enfoque UTE, 10 (3), Pp. 98–111. https://doi.org/10.29019/ENFOQUE.V10N3.493

Cires, D., Meier, U., Cires, D., and Meier, U., 2012. Multi-column Deep Neural Networks for Image Classification arXiv : 1202 . 2745v1 [cs. CV] 13 Feb 2012 Multi-column Deep Neural Networks for Image Classification. February.

Du, H., Shi, H., Zeng, D., Zhang, X.P., and Mei, T., 2022. The Elements of End-to-end Deep Face Recognition: A Survey of Recent Advances. ACM Computing Surveys (CSUR), 54 (10). https://doi.org/10.1145/3507902

Fabiyi, S.D., Murray, P., and Zabalza, J., 2022. New data analysis and dimensionality reduction methods for hyperspectral imagery. https://doi.org/10.48730/KQED-S704

Fabiyi, S.D., Murray, P., Zabalza, J., and Ren, J., 2021. Folded LDA: Extending the Linear Discriminant Analysis Algorithm for Feature Extraction and Data Reduction in Hyperspectral Remote Sensing. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 14, Pp. 12312–12331. https://doi.org/10.1109/JSTARS.2021.3129818

Faridi, M.S., Zia, M.A., Javed, Z., Mumtaz, I., and Ali, S., 2021. A Comparative Analysis Using Different Machine Learning: An Efficient Approach for Measuring Accuracy of Face Recognition. International Journal of Machine Learning and Computing, 11 (2), Pp. 115–120. https://doi.org/10.18178/ijmlc.2021.11.2.1023

Fuentes-Hurtado, F., Diego-Mas, J.A., Naranjo, V., and Alcañiz, M., 2019. Automatic classification of human facial features based on their appearance. PLoS ONE, 14 (1). https://doi.org/10.1371/JOURNAL.PONE.0211314

Garg, S., Hamarneh, G., Jongman, A., Sereno, J.A., Wang, Y., 2020. ADFAC: Automatic detection of facial articulatory features. MethodsX, 7. https://doi.org/10.1016/J.MEX.2020.101006

Gewers, F.L., Ferreira, G.R., De Arruda, H.F., Silva, F.N., Comin, C.H., Amancio, D.R., and Costa, L.D.F., 2021. Principal Component Analysis. ACM Computing Surveys (CSUR), 54 (4). https://doi.org/10.1145/3447755

Ghosh, S., Dasgupta, A., and Swetapadma, A., 2019. A study on support vector machine based linear and non-linear pattern classification. Proceedings of the International Conference on Intelligent Sustainable Systems, ICISS, Pp. 24–28. https://doi.org/10.1109/ISS1.2019.8908018

Greenacre, M., Groenen, P.J.F., Hastie, T., D'Enza, A.I., Markos, A., and Tuzhilina, E., 2022. Principal component analysis. Nature Reviews Methods Primers, 2 (1). https://doi.org/10.1038/s43586-022-00184-w

Greener, J.G., Kandathil, S.M., Moffat, L., and Jones, D.T., 2021. A guide to machine learning for biologists. Nature Reviews Molecular Cell Biology, 23 (1), Pp. 40–55. https://doi.org/10.1038/s41580-021-00407-0

Hassan, R.J., and Mohsin, A., 2021. Deep Learning Convolutional Neural Network for Face Recognition: A Review. https://doi.org/10.5281/zenodo.4471013

Huang, S.L., Xu, X., and Zheng, L., 2020. An information-theoretic approach to unsupervised feature selection for high-dimensional data. IEEE Journal on Selected Areas in Information Theory, 1 (1), Pp. 157–166. https://doi.org/10.1109/JSAIT.2020.2981538

Huang, W., Zhang, S., Zhang, P., Zha, Y., Fang, Y., and Zhang, Y., 2022. Identity-Aware Facial Expression Recognition Via Deep Metric Learning Based on Synthesized Images. IEEE Transactions on Multimedia, 24, Pp. 3327–3339. https://doi.org/10.1109/TMM.2021.3096068

Ibrahim, M.A.R., Shapiee, M.N.A., Abdullah, M.A., Razman, M.A.M., Musa, R.M., and Majeed, A.P.P.A., 2022. The Classification of Skateboarding Tricks: A Support Vector Machine Hyperparameter Evaluation Optimisation. Lecture Notes in Electrical Engineering, 730, Pp. 1013–1022. https://doi.org/10.1007/978-981-33-4597-3_93

Iyer, V., Shah, K., Sheth, S., and Devadkar, K., 2020. Virtual assistant for the visually impaired. Pp. 1057–1062. https://doi.org/10.1109/ICCES48766.2020.9137874

Izhar, F., Ali, S., Ponum, M., Mahmood, M.T., Ilyas, H., and Iqbal, A., 2023. Detection & recognition of veiled and unveiled human face on the basis of eyes using transfer learning. Multimedia Tools and Applications, 82 (3), Pp. 4257. https://doi.org/10.1007/S11042-022-13402-0

Jalaja, V., and Anjaneyulu, G.S.G.N., 2020. Face Recognition by Using Eigen Face Method. International Journal Of Scientific & Technology

Research, 9 (3). www.ijstr.org

Jyothi, M.L., and Shanmugasundaram, R.S., 2021. Combining Deep Residual Neural Network Features with Supervised Machine Learning Algorithms for Real-Time Face Recognition-Based Intelligent Systems. Ictact Journal on Image and Video Processing, 9102(November), 2. https://doi.org/10.21917/ijivp.2021.0367

Khan, F. N., Fan, Q., Lu, C., and Lau, A.P.T., 2019. An optical communication's perspective on machine learning and its applications. Journal of Lightwave Technology, 37 (2), Pp. 493–516. https://doi.org/10.1109/JLT.2019.2897313

Kherif, F., and Latypova, A., 2020. Principal component analysis. Machine Learning: Methods and Applications to Brain Disorders, Pp. 209–225. https://doi.org/10.1016/B978-0-12-815739-8.00012-2

Kortli, Y., Jridi, M., Al Falou, A., and Atri, M., 2020. Face Recognition Systems: A Survey. Sensors, 20 (2), Pp. 342. https://doi.org/10.3390/S20020342

Krishna, I., Kanth, R.M., and Sowjanya, V., 2022. Machine Learning Based Face Recognition System. ECS Transactions, 107 (1), Pp. 19979–19990. https://doi.org/10.1149/10701.19979ECST/XML

Leonardis, A., Bischof, H., and Maver, J., 2002. Multiple eigenspaces. Pattern Recognition, 35 (11), Pp. 2613–2627. https://doi.org/10.1016/S0031-3203(01)00198-4

License, C.A., Ren, Z., and Zheng, W., 2023. Retracted: Research on Face Recognition Algorithm Based on Image Processing. Computational Intelligence and Neuroscience, Pp. 1–1. https://doi.org/10.1155/2023/9847601

Liu, P., Wang, Z., Liu, N., and Peres, M.A., 2023. A scoping review of the clinical application of machine learning in data-driven population segmentation analysis. Journal of the American Medical Informatics Association, 30 (9), Pp. 1573–1582. https://doi.org/10.1093/jamia/ocad111

Mahesh, B., 2020. Machine Learning Algorithms - A Review. International Journal of Science and Research, 9 (1), Pp. 381–386. https://doi.org/10.21275/ART20203995

Miao, S., Xu, H., Han, Z., and Zhu, Y., 2019. Recognizing facial expressions using a shallow convolutional neural network. IEEE Access, 7, Pp. 78000–78011. https://doi.org/10.1109/ACCESS.2019.2921220

O'Toole, A.J., Phillips, P.J., Jiang, F., Ayyad, J., Pénard, N., and Abdi, H., 2007. Face recognition algorithms surpass humans matching faces over changes in illumination. IEEE Transactions on Pattern Analysis and Machine Intelligence, 29 (9), Pp. 1642–1646. https://doi.org/10.1109/TPAMI.2007.1107

Oloyede, M.O., Hancke, G.P., and Myburgh, H.C., 2020. A review on face recognition systems: recent approaches and challenges. Multimedia Tools and Applications, 79 (37–38), Pp. 27891–27922. https://doi.org/10.1007/S11042-020-09261-2/METRICS

Osisanwo, F.Y., Akinsola, J.E.T., Awodele, O., Hinmikaiye, J. O., Olakanmi, O., and Akinjobi, J., 2017. Supervised Machine Learning Algorithms: Classification and Comparison. International Journal of Computer Trends and Technology, 48 (3), Pp. 128–129.

Padmakar, V., and Murthy, B.V.R., 2021a. Face Recognition System with Machine Learning. Journal of Physics: Conference Series, 2089 (1). https://doi.org/10.1088/1742-6596/2089/1/012047

Padmakar, V., and Murthy, B.V.R., 2021b. Face Recognition System with Machine Learning. Journal of Physics: Conference Series, 2089 (1), Pp. 012047. https://doi.org/10.1088/1742-6596/2089/1/012047

Peng, P., Portugal, I., Alencar, P., and Cowan, D., 2021. A face recognition software framework based on principal component analysis. PLOS ONE, 16 (7), Pp. e0254965. https://doi.org/10.1371/JOURNAL.PONE.0254965

Saha, A., and Pradhan, S.N., 2018. Facial expression recognition based on eigenspaces and principle component analysis. International Journal of Computational Vision and Robotics, 8 (2), Pp. 190–200. https://doi.org/10.1504/IJCVR.2018.091980

Sarkar, I.N., 2022. Transforming Health Data to Actionable Information: Recent Progress and Future Opportunities in Health Information Exchange. Yearbook of Medical Informatics, 31 (1), Pp. 203. https://doi.org/10.1055/S-0042-1742519

Sarker, I.H., 2021. Machine Learning: Algorithms, Real-World Applications and Research Directions. SN Computer Science, 2 (3), Pp. 1–21. https://doi.org/10.1007/S42979-021-00592-X/FIGURES/11

Saveski, M., Awad, E., Rahwan, I., and Cebrian, M., 2021. Algorithmic and human prediction of success in human collaboration from visual features. Scientific Reports, 11 (1), Pp. 2756. https://doi.org/10.1038/S41598-021-81145-3

Schenkel, T., Ringhage, O., Márki, A., and Bae, J., 2019. A Comparative Study of Facial Recognition Techniques With focus on low computational power.

Shaheen, M., Awan, S.M., Hussain, N., and Gondal, Z.A., 2019. Modern Education and Computer Science. Modern Education and Computer Science, 7, Pp. 32–43. https://doi.org/10.5815/ijmecs.2019.07.04

Singh, G., and Goel, A.K., 2020. Face Detection and Recognition System using Digital Image Processing. 2nd International Conference on Innovative Mechanisms for Industry Applications, ICIMIA 2020 - Conference Proceedings, Pp. 348–352. https://doi.org/10.1109/ICIMIA48430.2020.9074838

Szostak, H., and Cohen, K., 2023. Deep Multi-Agent Reinforcement Learning for Decentralized Active Hypothesis Testing. https://arxiv.org/abs/2309.08477v1

Taskiran, M., Kahraman, N., and Erdem, C.E., 2020. Face recognition: Past, present and future (a review). Digital Signal Processing, 106, Pp. 102809. https://doi.org/10.1016/J.DSP.2020.102809

Thanathamathee, P., Sawangarreerak, S., Kongkla, P., and Nizam, D.N.M., 2023. An Optimized Machine Learning and Deep Learning Framework for Facial and Masked Facial Recognition. Emerging Science Journal, 7 (4), Pp. 1173–1187. https://doi.org/10.28991/ESJ-2023-07-04-010

Tharwat, A., Gaber, T., Ibrahim, A., and Hassanien, A.E., 2017. Linear discriminant analysis: A detailed tutorial. AI Communications, 30 (2), Pp. 169–190. https://doi.org/10.3233/AIC-170729

Tirthyani, D., Kumar, S., and Vats, S., 2024. Clustering and Unsupervised Learning. Pp. 119–139. https://doi.org/10.4018/979-8-3693-3609-0.CH005:

Traore, B.B., Kamsu-Foguem, B., and Tangara, F., 2018. Deep convolution neural network for image recognition. Ecological Informatics, 48, Pp. 257–268. https://doi.org/10.1016/J.ECOINF.2018.10.002

Ullmann, T.D., 2019. Automated Analysis of Reflection in Writing: Validating Machine Learning Approaches. International Journal of Artificial Intelligence in Education, 29 (2), Pp. 217–257. https://doi.org/10.1007/S40593-019-00174-2/TABLES/7

van Engelen, J.E., and Hoos, H.H., 2020. A survey on semi-supervised learning. Machine Learning, 109 (2), Pp. 373–440. https://doi.org/10.1007/S10994-019-05855-6/FIGURES/5

Weeraratne, N., Hunt, L., and Kurz, J., 2024. Challenges of Principal Component Analysis in High-Dimensional Settings when n < p. https://doi.org/10.21203/rs.3.rs-4033858/v1

Wen, J., Fang, X., Cui, J., Fei, L., Yan, K., Chen, Y., and Xu, Y., 2019. Robust Sparse Linear Discriminant Analysis. IEEE Transactions on Circuits and Systems for Video Technology, 29 (2), Pp. 390–403. https://doi.org/10.1109/TCSVT.2018.2799214

Yadav, A.K., Pateriya, R.K., Gupta, N.K., Gupta, P., Saini, D.K., and Alahmadi, M., 2022. Hybrid Machine Learning Model for Face Recognition Using SVM. Computers, Materials and Continua, 72 (2), Pp. 2697–2712. https://doi.org/10.32604/cmc.2022.023052

Zhang, Y., Kang, B., Hooi, B., Yan, S., and Feng, J., 2023. Deep Long-Tailed Learning: A Survey. IEEE Transactions on Pattern Analysis and Machine Intelligence, 45 (9), Pp. 10795–10816. https://doi.org/10.1109/TPAMI.2023.3268118