International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 12 | December - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

Signup System based on Face Recognition using CNN

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Abstract-These days, a lot of people are researching face recognition attendance systems due to its many advantages, one of which is the ability to use facial technology for attendance. people used faces to identify each other. In the same way, computers can recognize humans using a particular set of algorithms. Face recognition algorithms can be integrated with simple neural networks to increase accuracy, but at the expense of slower performance. Face recognition can also be used to identify people, take their photos, and improve surveillance. To increase accuracy, one can employ algorithms like CNN and Yolo. Facial recognition can be performed with easily using correctly labelled datasets, which can be labelled automatically or by hand. It is possible to recognize simple patterns to identify persons from a picture and recognize them. Accuracy can be increased by using proper limits. According to experimental data, the face recognition system can identify faces up to 80% of the time. About 62% less time is spent with the facial recognition attendance system when compared to the normal check-in method. The issue of students leaving early and skipping lessons has greatly decreased in relation to the rate of absences. The above experimental certification allows the face recognition time and attendance system with real-time video processing to quickly finish student tasks in the time and attendance check-in system, eliminate the difficult naming issue, greatly improve classroom performance, and act as an important factor in the system's development.

KEYWORD:

Face recognition technology, Face recognition attendance, attendance system, Convolutional neural networks, image processing, image recognition.

I. INTRODUCTION

Computer technology has become an integral part of people's lives and work, with face recognition technology playing a significant role in this field. Face recognition is a combination of artificial intelligence and computer, with broad application prospects in areas such as public safety, civil economy, and home entertainment. Despite the challenges of fingerprint and card attendance systems, face recognition technology offers higher accuracy and stability due to its more points for recognition. China's research on face recognition technology has been slow, but leading figures have established their industry positions. With the advent of big data and the commercial value of face recognition technology, the future of this technology is bright and has great market demand.

To overcome challenges in video-based face recognition, Ding C proposed a comprehensive framework based on convolutional neural network (CNN). This framework artificially blurs training data with still images and artificial fuzzy data to learn fuzzy insensitive features. CNN also proposes a trunk branch CNN model (TBE-CNN) to enhance the robustness of CNN features to pose changes and occlusion. Designing a face recognition attendance system based on real-time video processing can positively impact the development of enterprises and future enterprises. This article aims to design a face recognition time and attendance system based on real-time video processing, demonstrating the effectiveness of face recognition technology in achieving expected results [1].

Deep learning algorithms have achieved significant developments in various fields of computer vision, such as image classification, object detection, segmentation, and face recognition. CNN-based algorithms provide state-of-the-art performance in computer vision problems by applying convolution filters and various nonlinear activation functions. However, traditional shallow learning techniques have limitations, such as assuming that an image of the whole face can be taken for effective recognition.

To address these limitations, a system to distinguish between masked, unmasked, and incorrect masked individuals was proposed and validated using a mobile application called MADFARE (Masked Face Recognition app). The main contributions of this paper include a lightweight deep learning model, a novel algorithm using only eye images to detect an individual's identity, a transfer learning approach to enhance recognition performance, and a mobile application to detect improper use of face-masks in real-time to offer preventive action for the Covid-19 pandemic [2].

Facial features, including nose, eyes, mouth, wrinkles, and advanced properties like gender and emotion, are a crucial area in face technology. They consist of three levels: high-level features, which are extracted from low-resolution images, and micro-level features, which require high spatial frequency images. Facial features are used in face recognition and age estimation, but they face challenges due to age-related inclusions and changes in facial expression over time. Age estimation is crucial for determining the exact age or age range. Aging is an uncontrollable process that affects face recognition, and it can be used to find missing children through law enforcement and forensic investigation systems. Face techniques face challenges such as the lack of labelled data for real age estimation and high human error in estimating a person's real age. This study reviews different face recognition and detection techniques, focusing on the problems of face recognition, challenges, methods, architecture, advantages, and limitations. The study concludes with promising future directions [3].

Machine learning on edge computing nodes is gaining popularity, enabling data processing at the edges of the network. Edge computing reduces traffic, cloud computing, storage resources, response time, and data latency, making data transmission more secure. Face recognition has implications for making class rooms smart, as data produced at the edge of the network is large and requires processing at the edges to reduce latency.

The proposed algorithm utilizes the CNN, a deep learning approach and state-of-the-art in computer vision, to achieve better results. The model can recognize people even when frames have multiple faces and recognizes people from different positions and under different lighting conditions. Edge computing has been utilized to improve data latency and response time in real-time.[4]

Students may resort to unethical activities, such as not attending class but maintaining their status as "online." Additionally, it is difficult to determine whether a student is actively participating in the class or simply being online without paying attention.

In response to these challenges, researchers have introduced the Random Interval Attendance Management System (RIAMS), an automated system designed to monitor students' attendance and engagement in virtual classrooms at random intervals. The system uses an AI Deep CNN model to capture face biometrics from students' video streams and record their attendance automatically. The main component of the proposed model is a face recognition module built using AI-DL tools, along with submodules for assessing students' responses to CAPTCHAs and UIN queries.

The Random Interval Attendance Management System model is the simplest and best approach to automatically capture attendance during virtual learning, as it quickly monitors attendance without hindering the learning process. It can generate dedicated attendance reports and prevent dropouts from the virtual classroom. Additionally, the Random Interval Attendance Management System design does not affect the teaching-learning process, as random intervals required for attendance tracking are too short (30 seconds or less). [5]

II. RELATED WORK

1. FACE RECOGNITION:

The Region Proposal Network (RPN) is a lightweight face detection system that draws anchors and outputs the most likely anchors to contain objects. The RPN scans images using sliding windows over the anchors, returning the anchors with the maximum probability of containing objects. The loss function is calculated using the intersection over union overlap, with positive values assigned to anchors greater than 0.7 and negative values assigned to those less than 0.3. The RPN uses a backbone feature map architecture to extract features efficiently and avoid duplication. The model predicts two outputs: one for the classification of the detected object and another for the bounding box size and location. However, classification requires a fixed image size, which is solved using ROI pooling. The backbone architecture for convolution features for classification of detected objects is described in the methodology section.

T = min {T1, T2, · · ·, Tn}

2. CNN FOR FACE RECOGNITION PROPOSED:

Deep convolution neural network design is primarily developed for 2622 distinct entity recognition. organized to address the N-ways classification issue. CNN was used for every training period. Ix, x = 1.... X, the formula for calculating a score is yx = wπ(Ix) + BεR. In utilizing with N linear predictors ε, the last fully-connected layer SB\R, n×D In n for a single identity each. Following these scores are contrasted with each class's ground truth label to Determine the lost amount. Following training, the layer of classification has been eliminated, and the facial score vectors are being utilized employing the Euclidean distance for verification. The chopped face is the input used in our proposed architecture. is the facial cropping 224 x 224 x 3 picture. It is made up of eight blocks in total. Three blocks are fully connected, and five blocks are convolutional linked strata. Table 1 presents the parameters of the convolution architecture. Every convergence layer, and non-linearities like rectification come next. Max Pooling and the Re LU layer. Since three are completely connected layers, with the first two completely connected layers' output These are the final completely connected layers, each 4096 dimensional. layers output is N = 2622 dimensions based on the number of the dataset's classes that are used. The soft max layer was put in order to normalize the unnormalized vectors and include the predictions into the second fully connected layer. statistical format.

3. TRAINEE SECTION OF THE SUMMARY NETWORK:

The Labelled Faces in the Wild dataset is a database for unconstrained face recognition that is used by the suggested algorithm. More than 13,000photographs representing 5749 distinct people are included in the dataset; over 1620 of these individuals have two or more unique photos. Finding the ideal parameters to reduce average data loss following the soft max layer is the primary goal. Patches with a size of 224 by 224 pixels are fed into the network, and the weights are initialized using Gaussian Mixture random sampling. Stochastic gradient descent is used to improve weights after data augmentation.

4. LOSS FUNCTION:

The loss function is a crucial tool in machine learning and deep learning algorithms, used to calculate the error between actual and predicted labels. It measures the model's performance on given data and can be reduced with optimization parameters. The Mean Square Error is a commonly used loss function, measuring the difference between actual labels and predictions. It penalizes predictions far from actual values, affecting the computation power due to the large data set and deep neural architecture complexity.

5.FACE DETECTION VIA DEEP LEARNING:

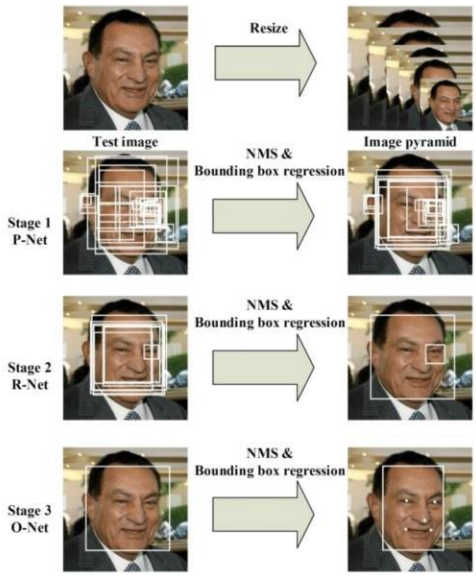

Figure1: face detection via deep learning

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The amount of data produced by Internet of Things (IoT) devices has increased significantly, making it necessary to process this data at the edges of the network rather than passing it to the cloud. Techniques like micro-data centres, fog computing, and cloudlets have been utilized for IoT-based architectures, but they are not suitable for processing large amounts of data at the edges. Edge computing processes data at the edges of nodes, including computing devices, network resources, and dedicated paths between generated data sources and cloud data centres. Cloud computing is not suitable for tasks involving visual data processing due to long data latency and late response. Edge computing is more focused on the things, while fog computing is more concerned with the infrastructure side. In a proposed system, a face recognition system is set up in smart class rooms, where images from different rooms are sent simultaneously for processing to take attendance. The gateway device is connected to the class rooms, and the necessary cloud data is synchronized into the gateway device after a specific time stamp. The proposed edge computing architecture uses the Csharp.Net user interface and backend services, a face recognition model, and HTTP M2M protocol for data transfer between devices and micro servers.

6.THE MAIN FACE RECOGNITION METHODS:

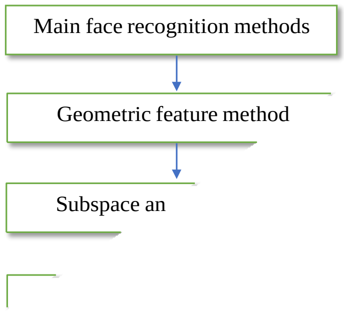

Figure2: main face recognition methods

A. GEOMETRIC FEATURE METHOD:

The main face recognition methods include geometric feature methods, subspace analysis methods, neural network methods, and support vector machine (SVM) methods. Geometric features are used to describe and recognize the side profile of a human face, which is simple and efficient in terms of storage space and classification.

B. SUBSPACE ANALYSIS METHOD:

Subspace analysis methods map face image data into a certain subspace to achieve dimensionality reduction, making it easier to calculate and classify.

C. NEURAL NETWORK METHOD:

Neural networks are commonly used in membrane recognition, but they have limitations such as large and complex structures, long training times, and slow speed. Support vector machines (SVM) are research hotspots for pattern recognition, but they have limitations such as being two-class classification algorithms, requiring high-dimensional space projection, and often requiring feature extraction.

D. SUPPORT VECTOR MACHINE (SVM) METHOD:

A video image recognition system uses face detection technology to locate and segment partial face images, extract feature data, and form features to be stored in a feature database. This process includes face positioning, image processing, feature extraction, selection, detection, and recognition. The face coding method works according to essential characteristics of the human face and can accurately identify individuals from millions of people.

7.IMAGE RECOGNITION SYSTEM:

The image recognition system consists of four parts: login module, recognition module, check-in module, and background management module. The login module allows the lecturer or background administrator to view attendance information, while the recognition module performs face recognition on the picture and obtains an identification code. The check-in module compares the identification code with student information in the database, and the background management module handles background administrator functions. face recognition methods involve various techniques, including geometric feature methods, subspace analysis methods, neural networks, and video image recognition systems. Each method has its advantages and disadvantages, and their implementation is crucial for effective face recognition.

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III. PROPOSED METHOD

Face detection, face recognition, and attendance management are some of the components that go into designing a face recognition attendance system. This is a suggested procedure for developing such a system:

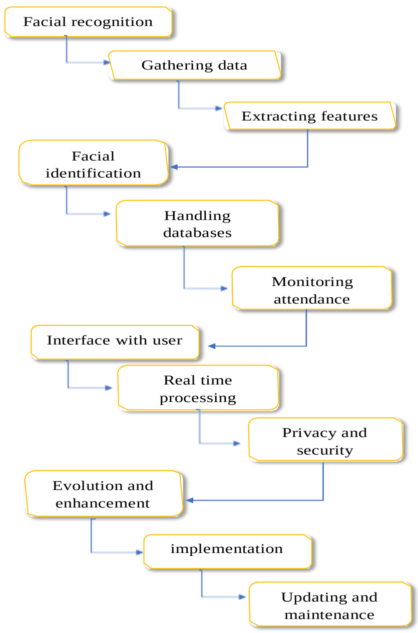

Figure3: classification of face recognition

1. Facial Recognition:

Employ a face identification technique (such as MTCNN, SSD, or Haar cascades) to identify and extract faces from pictures or video frames. To increase the system's accuracy, remove any non-face items, multiple faces, and poor-quality photos.

2. Gathering Data:

Compile a list of the faces of the people whose attendance you wish to monitor. Every person should have several pictures shot from various angles and in different lighting.

3. Extracting Features:

Employ a Convolutional Neural Network (CNN) or other deep learning model to extract features. For facial recognition, pre-trained models such as ResNet, VGG16, or Mobile Net can be refined. Use your face dataset to train the model so that it can extract distinguishing features from faces.

4. Facial Identification:

Apply a facial recognition algorithm utilizing the features that the model has extracted. A Siamese network or a Triplet Loss function are two popular methods for determining face similarity. Define a cutoff point for similarity scores to determine whether the identified face corresponds with any enrolled face.

5. Handling Databases:

Keep the feature vectors that were taken from the enrolled faces and the matching user IDs in a database. When new users are enrolled, update the database.

6. Monitoring Attendance:

To identify a person whose face has been detected, compare the retrieved features with the database. Mark the current time and date to reflect the user's attendance if a match is detected.

7. Interface with User:

Create an intuitive user interface so that teachers, administrators, and users can communicate with the system. Administrators have access to attendance data and can add or delete users, while users can check their attendance.

8. Batch or Real-time Processing:

Choose if the system should process photos and videos in batches or in real time (for example, using a webcam).

9. Privacy and Security:

Put security measures in place to safeguard the database and guarantee that unauthorized users are unable to take control of the system. Take privacy concerns into account and abide by applicable data protection laws.

10. Evaluation and Enhancement:

Conduct extensive testing of the system using a variety of faces and situations to guarantee correctness and dependability. Adjust the system settings and the model as necessary.

11. Implementation:

Install the system where it is supposed to be, be it a workplace, a classroom, or somewhere else.

12. Updating and Maintenance:

Update the software and model on a regular basis to fix security flaws and increase accuracy. Offer assistance and upkeep to guarantee the system's continuous operation.

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YOLO (You Only Look Once):

For the detection of the objects by the facial recognition, it uses the YOLO algorithm. Here YOLO stands for You Only Look Once technology which is introduced to detect the object by capturing the images of the objects through camera. The captured images will be processed and form an image by highlighting the detected objects through boxes. It uses the Conventional Neutral Network for the object detection. The following block diagram will describe the YOLO algorithm flow of execution for detection.

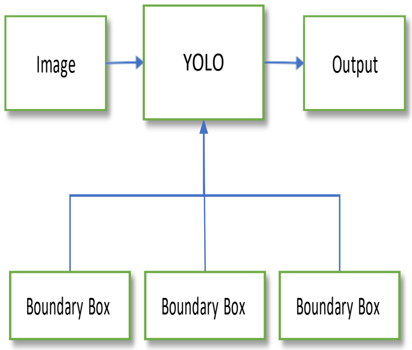


Figure4: convolution neural network

As shown in the above flow of YOLO it takes an input as a form of images or videos. Then that image will be processed by the YOLO and provide the output. It consists of three stages, initially the image will convert into SxS grid, each grid having same space. Then it highlights the object through bounding boxes. The Intersection of Union will be finding the exact object. The process will be followed;

Image: The input image is fed into the YOLO network.

YOLO: The YOLO network processes the image and predicts bounding boxes and probabilities for each object in the image.

SxS Grid: The image is divided into an SxS grid. Each grid cell predicts multiple bounding boxes for different object classes.

IoU: The IoU (Intersection over Union) between each predicted bounding box and the ground truth bounding box is calculated.

Boundary Box: The bounding box with the highest IoU is selected as the final prediction for that object.

The YOLO algorithm is very fast and efficient, making it ideal for real-time object detection in

CNN (Conventional Neutral Network):

This is one of the type of object detection technique used in face recognition. This techique is already used in the YOLO algorithm. This algorithm consists of multiple number of layers to process the input image or video and each layer works differently. This technique is a two stage detection, because it predict the object by twice and then it will detect the objects. Each layer consists of multiple number of neutrons and each neutron in that layer have the interconnection between each consecutive layers. The following block diagram will descries about the CNN

HAAR CASCADE:

Haar cascades are a machine learning object detection method that is commonly used in computer vision applications, including face recognition systems. However, using Haar cascades for attendance systems that recognize faces typically involves several steps. Here's a general overview of how you can implement a face recognition attendance system using Haar cascades:

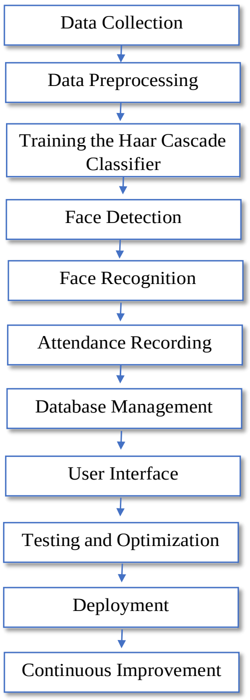


Fig5: process of Haar cascade

1. Data Collection:

Collect a dataset of images containing the faces of individuals you want to recognize.

2. Data Preprocessing:

Crop and resize the face regions in the images to a consistent size. Convert these face images to grayscale to reduce computational complexity. Label the images with the corresponding individual's identity.

3. Training the Haar Cascade Classifier:

Use the OpenCV library or other image processing tools to train a Haar Cascade classifier specifically for detecting faces. The training process involves both positive (images containing faces) and negative (images without faces) samples. This classifier will learn features that help in detecting faces in images.

4. Face Detection:

Use the trained Haar Cascade classifier to detect faces in input images or video streams. For each frame or image, run the Haar Cascade classifier to detect faces, and you'll receive a set of bounding boxes around detected faces.

5. Face Recognition:

Once faces are detected, you can use a face recognition algorithm to identify and recognize individuals. There are various face recognition algorithms available, such as Eigenfaces, Fisher faces, Local Binary Patterns Histograms (LBPH), or deep learning-based methods like Convolutional Neural Networks (CNNs). Train your face recognition model on a dataset of face images associated with specific individuals.

6. Attendance Recording:

Once an individual is recognized, record their attendance, typically by marking the timestamp when their face is detected.

7. Database Management:

Maintain a database that links individuals' identities with their attendance records.

8. User Interface:

Create a user-friendly interface that allows administrators to manage the attendance system, view attendance records, and generate reports.

9. Testing and Optimization:

Test the system in different lighting conditions and with various individuals to ensure accuracy. Optimize the system for real-world use cases, addressing false positives and false negatives.

10. Deployment:

Deploy the system in the intended environment, such as an office, classroom, or any place where you want to track attendance.

11. Continuous Improvement:

Regularly update and refine the system to improve accuracy, security, and performance.

IV. RESULT

A. IMPLEMENTATION DETAIL:

TensorFlow deep learning framework is utilized to train the suggested architecture. CUDDN for Nvidia Libraries have been employed to expedite the process of training. using the GPU's assistance. Utilizing an Nvidia 1080 Ti GPU, the dataset's training.

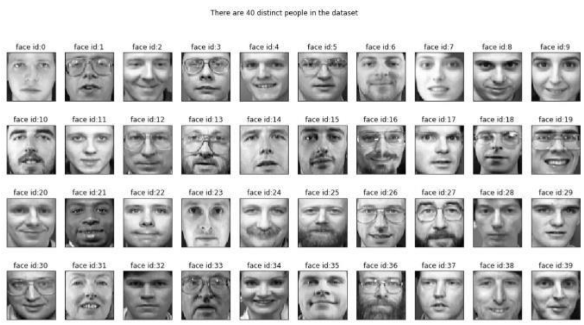


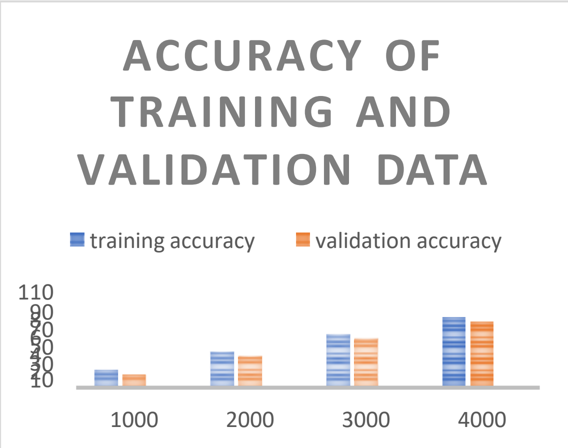
Figure6: collection of facial samples

B. EVALUATION:

The suggested method has undergone both quantitative and qualitative assessments. A database including the face encodings of 35 pupils was used for quantitative testing of the system. The system's recognition accuracy was 85.5%, and its face detection accuracy was 94.6%. It received a 99.64% mean accuracy rating after 3000 face pairs were assessed qualitatively.

	Total students	Detected faces	Recognize faces
Class A	45	45	42
Class B	48	47	45

Class C	51	48	46
Class D	50	50	49
Class E	41	39	36



Graph1: accuracy of training and validation data

The LFW wild dataset was used to train the suggested model, which was divided into 80% training and 20% validation. With a maximum accuracy of 97.9% on validation data, the learning rate was determined by analysing the training data's loss value. The model was tested up until the minimum loss value was attained; on the validation set, a large loss value indicated inaccurate predictions. A significant issue with deep neural network training is overfitting, when the training dataset provides the model with features and noise, which causes the model to perform inaccurately on unobserved data. A drop-out value of 0.7 was chosen to avoid overfitting; this value can be raised in response to variations in training and validation loss and accuracy.

V. CONCLUSION

College attendance management is a pressing issue in society, and traditional methods like paper signatures and teacher orders are still used. However, advancements in technology have led to the use of punch card fingerprints and smart attendance methods. These methods can lead to fraud and increased absenteeism, negatively impacting students' psychology and physiology, maintaining normal university teaching order, and hindering the quality of teaching. This article proposes a face recognition attendance system based on real-time video processing, which is tested in two colleges in a province. The system's accuracy rate is 82%, and the system is more stable and correctly identifies check-ins than manual fingerprint punching. The system also significantly reduces the rate of skipping classes compared to the control group, which is only 13%. The attendance system uses face recognition technology with the help of a computer, resulting in improved attendance rates and reliability. The system has made significant innovations, making it a worthy subject for further exploration and realization by scientists.

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