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An Effective Implementation of Autonomous Attendance System using Convolution Neural Networks

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Abstract ***Attendance marking is a common method used by all educational institutions at all levels to keep track of students' daily presence. Previously, attendance was recorded manually. These procedures are precise and remove the possibility of enrolling false attendance, but they are time-consuming and labor-intensive for a big number of pupils. Autonomous systems based on radio frequency recognition scanning, fingerprint scanning, face recognition, and iris scanning are being developed to address the drawbacks of manual systems. Each strategy has pros and cons. Furthermore, most of these systems are limited by the requirement for one-on-one human interaction to record attendance. In this work, we developed a durable and effective attendance recording system based on a single group photograph that detects face identification and recognition algorithms to solve the limitations of existing human and autonomous attendance management systems. Using a high-definition camera mounted in a fixed position, a group of photos is collected for all of the students sitting in a classroom. Following that, using a typical approach, photos of the faces are extracted from the group photo, followed by identification using a convolution neural network acquainted in a student face database. We tested our approach using a range of group pictures and datasets. In terms of efficiency, convenience of use, and implementation, the suggested framework beats existing attendance tracking systems, according to our findings. The suggested system is a self-contained attendance system with minimal human-machine interaction, making it simple to integrate into a smart classroom.***

Keywords: ***Attendance Recording, Autonomous system, Convolution Neural Network, Face Recognition, Iris Scanning, Smart Class room.***

I. INTRODUCTION

One of the usual security procedures seems to be the evaluation criteria that determine the presence of a person in a room or place. Every individual who enters a room or building must first go through a series of authentication procedures, so that these details may later be utilized to monitor every single activity in the space for security purposes. The authentication mechanism for identifying a person's presence in a room or facility is still evolving. Depending on whether a name and signature are recorded in the attendance list, an identification card is utilised or biometric verification technologies such as a fingerprint or face scanner are employed, the procedure varies. One of the most promising approaches has emerged: biometric authentication. The biometric authentication approach used, however, is still ineffective and takes a long time to complete. The fingerprint scanner requires the user to insert their finger into the scanner, whereas the face scanner requires the user to change their face position to match the location of the scanner. This project will offer a facial recognition authentication mechanism using a web camera.

Marking attendance would be a regular practise in both schools and workplaces. Attendance is regarded as crucial in educational institutions, both for students and instructors. Keeping track of student attendance in a classroom can be challenging. There are two types of attendance systems available: manual and automatic. The most common manual attendance method is the roll call technique, in which a teacher records presence by calling out the students' names one by one. The approach is antiquated, and in the case of a large class, it may take more than 10 minutes per day and has the greatest number of proxy attendance marking opportunities. The second method is to sign an attendance record or sheet. Because it is easily manipulated and faked if left unmanaged, this is the most time-consuming stage. Modern biometric approaches are emerging as one of the most promising authentication methods when compared to traditional authentication techniques. Putting a person's name, address, and signature on a piece of paper is the standard authentication technique, as is giving someone access to a physical or virtual environment via a password, PIN (Personal identifying number), smart card, plastic card, token, key, or other means. Passwords and PINs are difficult to remember and, in many cases, easy to steal or suspect. One of them is the use of facial recognition as a biometric authentication mechanism. As technology progresses, automatic attendance systems based on RFID tag scanning are also being deployed [1]. Each student has a unique tag that is scanned in these systems to determine attendance. The system's flaws include extensive hardware requirements, a tag for each student, proxy attendance via tag exchange among peers, and just one human-system interaction for marking attendance.

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Numerous automatic attendance systems based on fingerprint scanning, iris scanning, and face identification have evolved as a result of image processing in attendance systems.

The first biometric attendance system used fingerprint scans as its biometric input [2]. Every student has a unique fingerprint that is scanned to keep track of their attendance. One of the system's flaws is that it can only record one attendance at a time and that it requires a lot of human-machine interaction during the process. Fingerprint cards were no longer required as a proxy with the iris scan-based attendance system. This system examines a pupil's iris pattern to track attendance [3]. Face recognition is also often used to identify people in a large crowd or location. Facial recognition is also being used by institutions to track attendance. Face recognition, fingerprint, and iris scanning-based attendance systems have the disadvantages of being time consuming, needing more human-machine interaction because only one student can register attendance at a time, and being impracticable to utilize in big courses.

The significant computation required during classifier training is one of the remaining flaws in the face detection approach. This difficulty was solved by Minh-Tri Pham and Tat-Jen Cham [7], who used statistical techniques to minimize the time necessary for training. The findings were fairly impressive in terms of decreasing the necessary processing time. Several of the most widely used face recognition-based attendance systems have already been examined. Jayant et al. used hybrid face recognition algorithms to track attendance [4]. Ofualagha et al. employed FACECUBE to track attendance [5]. D'Souza et al. used a histogram-based facial recognition algorithm to construct an attendance marking system [6]. As a result, developing an intelligent attendance system that can reliably record attendance without requiring human contact is crucial.

Because it is a nonintrusive methodology, pictures can be acquired from a distance, it is a cost-effective option, there is no danger of proxy attendance being recorded, and it is a user-friendly yet dependable way, the biometric system is the most practical solution in building attendance systems. We used video from a camera and facial recognition and recognition to construct an automatic attendance system in this investigation.

II. PROPOSED Vs EXISTING SYSTEM

Biometrics such as fingerprint and iris scans are used in the attendance system. Face recognition is accomplished using the Viola Jones algorithm. The model's accuracy is good when compared to existing systems. The bulk of existing systems employ finger print and manual process attendance methods. Employees or students may easily cheat businesses in a manual procedure. During pandemics, the finger print-based technique may result in an excess of covid-19.

A. Image Gathering

The suggested system accepts data from both online and offline sources, including live and recorded video. In online mode, live video is taken from the camera linked through IP address; however, in the event of internet connectivity issues, recorded videos saved in the camera memory are used in offline mode.

B. Algorithm for recognition

It is necessary to build a database for training the recognition algorithm before the system may begin tracking attendance. To do so, we must first create a database containing student face pictures and other information. Individual or group video is used to capture the facial images. Individual student face shots are automatically chopped and placed in the appropriate files based on their different identities in the group film. Trimming each image from the group input individually, on the other hand, could be time consuming. As a result, another path has been added.

The second method is importing a film with only one pupil and editing and saving the required number of face shots in various poses in a designated folder. This technique is easy and quick. In the next phase, the basic information about students is saved in a file for attendance tracking. This information can be used to notify students at any time in order to keep track of their attendance.

C. Attendance Verification

From the user's standpoint, the attendance marking technique is straightforward and completely automated. When the start button is pressed, the operation begins and lasts approximately 15 minutes until the results are displayed and saved. The first frame is collected after loading a live video into the software. The detection method is used to detect the children's faces, which are subsequently cropped and saved in a distinct folder. The clipped faces are then recognized using a recognition strategy that employs a trained deep learning convolution neural network model. Finally, the number of people who have been acknowledged is recorded. When the recognition phase is finished, the remaining and unrecognized faces in the class are marked absent. To save memory, the chopped faces from the intermediate phases are removed. The method is repeated for the next 15 frames, ensuring that all present pupils are identified, even if they were not captured in one of the frames. Finally, average attendance is determined, and pupils with attendance above a certain percentage threshold are classified present, while those with lower attendance are labeled absent. The report is retained for future use for each topic and lecture, and the total number of students present is displayed on the App interface [8-20].

III. PROPOSED METHODOLOGY

One of the usual security procedures seems to be the evaluation criteria that determine the presence of a person in a room or place. Every individual who enters a room or building must first go through a series of authentication procedures, so that these details may later be utilized to monitor every single activity in the space for security purposes. The authentication method for detecting the presence of a person in a room or building is still in flux.

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The procedure differs depending on whether a name and signature are written in the attendance list, an identification card is used or biometric verification technologies such as a fingerprint or face scanner are used. For face identification from a group picture, the suggested system employs the DCNN Algorithm. Face data is obtained from the user in the first stage using OpenCV tools. From the user, over 1000 photos have been collected.

Gray scale conversion, resizing, normalization, and augmenting are four critical phases in the preprocessing of the obtained data. On the processed data, the CNN architecture was installed and trained. The automatic facial detection block stores and deploys the learned model. The proposed model aids in the precise identification of trained faces. Attendance is recorded if the face is recognized.

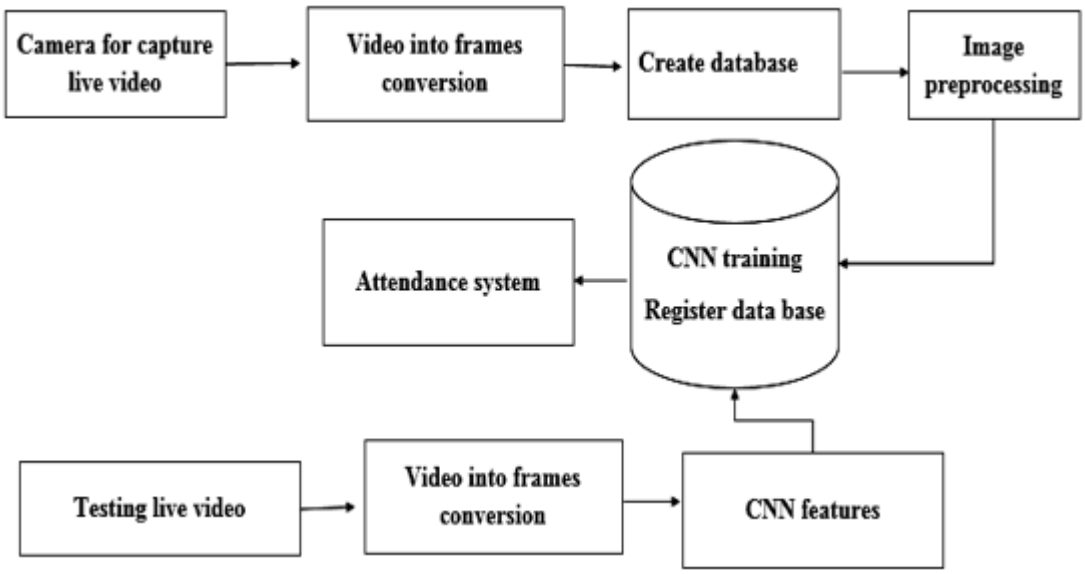

Fig 1. Block diagram of proposed model

In this proposed face recognition group face picture attendance system using YOLO Algorithm. This work is a live attendance system based on facial recognition algorithms. It is a smart, one input, and many outputs attendance system. This solution solves the issues that arise with standard systems.

IV. CNN ARCHITECTURE

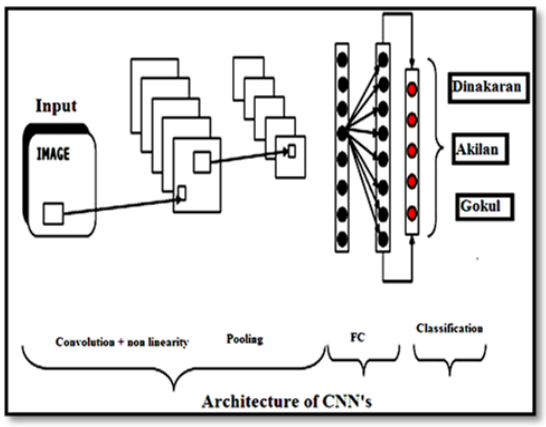

Fig 2. Image classification in CNN Architecture

This research work describes the image classification using deep neural network combined with HOG feature extraction with K-means segmentation algorithm and classifies through SVM classifier for more accuracy. The following advantage of proposed system

1) The proposed CNN method reduces the number of preprocessing steps.

2) Extra shape feature extracted from HOG algorithm for provide the better accuracy.

3) SVM classifier reduced the complexity of work and improved the robustness of system.

A. Deep neural network

A Complete 2D dimensional neural network consist of number of image input layer, convolution layer ,Re Lu layer, Max pooling 2D layer ,Fully connected layer ,Soft max Layer and classification layer ,the detail description of each layer of classifiers compete .

- **Image input layer:** The Image input Layer learn the feature from the input image. The first step define pixel of input image, the image size define (50:50).
- **Convolution layer:** The convolution layer extract the features of image from the image input layer.CNN layer consists of one or more kernel with different weight that are used for extract the features of input image. Depending on weights associated with each Filter we can extract the feature of image.
- **Pooling layer:** Down sampling of image convolved features is applied by the pooling layer. When the input picture is found to be nonlinear the dimension of the image's features map is provided by the pooling layer.
- **Fully connected layer:** The layer that is completely interconnected the 26 classes of image data, the above layer of five blocks interconnected which is classified by the fully connected layer of system, based on the class score we can classify the predicted score.

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V. YOLO ARCHITECTURE

(You Only Look Once) are a Deep Learning (DL) network that detects objects. YOLO recognizes objects in photos by categorizing them and determining their location with respect to one another. For example if you give a YOLO network an image of a herd of sheep, it will generate a vector of bounding boxes for each individual animal and classify it accordingly. There are three main components to a YOLO network. The predictions vector, often known as the algorithm, comes first. The network, on the other hand, is a separate entity. The loss functions are the final step.

1. The YOLO Algorithm

When you feed an image into a YOLO algorithm, it splits it into a SxS grid that it uses to forecast if a given bounding box contains the item (or portions of it) and then predicts a class for the object. We must first understand how the algorithm constructs and specifies each bounding box before we can go into depth and describe how it works. To forecast an output, the YOLO algorithm employs four components and an extra value.

- A bounding box's centre (bx by)
- Dimensions (bw)
- Dimensions (bh)
- The object's classification (c)

Confidence is the final anticipated number (pc). It denotes the likelihood of an object existing within the bounding box. The centre of the enclosing box is represented by the (x,y) coordinates. We must utilize the pc prediction since majority of the bounding boxes will not contain an item. We may delete unneeded boxes with a low chance of containing objects and those that share large regions with other boxes using a technique called non-max suppression.

2. Video capture

The OpenCV library in Python has been used to capture video from a camera.

3. Frame conversion

The video was captured and translated into picture frames. 30 frames have been extracted each second.

4. Image Processing

The collected images will be resized and converted into gray scale images.

5. Model training

The CNN model is trained on the preprocessed picture. The model was put upon this attendance system after the training procedure was finished.

6. Attendance system

The camera will be turned on during this operation, and all of the faces with in frame will be captured. The attendance entries are made if the trained face is identified in the frame.

7. Dataset creation

Dataset to student is built in this module using OpenCV-python. A dataset was created by collecting 1,000 images in each and every student.

8. OpenCV

Computerized vision is a method for understanding how photos and movies are stored, as well as manipulating and retrieving data from them. OpenCV may be used to analyse images and movies in order to recognise objects, people, and even human handwriting. Face identification, object recognition, and medical image analysis are some of the applications of OpenCV.

9. Model development

The developed model is used to track student attendance using a facial detection code.

VI. EXPERIMENTAL RESULTS

The suggested system's expected outcome is to automatically mark attendance for students in the class utilizing single group video. The attendance is eventually recorded in an excel sheet depending on the presence or absence of the student, which is recognized using facial recognition in the aforementioned model.

A. Data set Creation

Fig 3. Creating Students data set

In this work, dataset of 1000 images separated into three processes: training, validation and testing. Pre-processing the data such as resizing and grey scale is the first step. So it is resized the image to standard format.

B. Data Collection

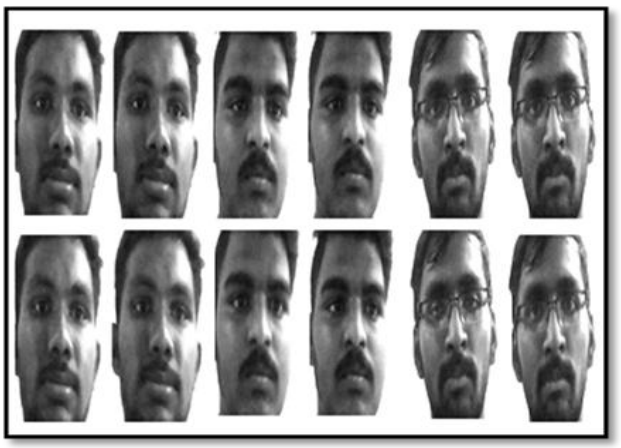

Fig 4. Sample data collection

In this work, we are collected samples of three student's data and processed for face extraction. For training the ML model the following actions are carried out for pre-processing process. Here the combinations of multiple data set to get a large corpus. Normalization reduces the size by the order of magnitude of data.

C. Face extraction

After creating database, the data sets are introduced into image preprocessing after that the images are trained and stored in CNN data base. In that frame conversion and image extraction are performed in this section. Finally, the images are classified according to their CNN features.

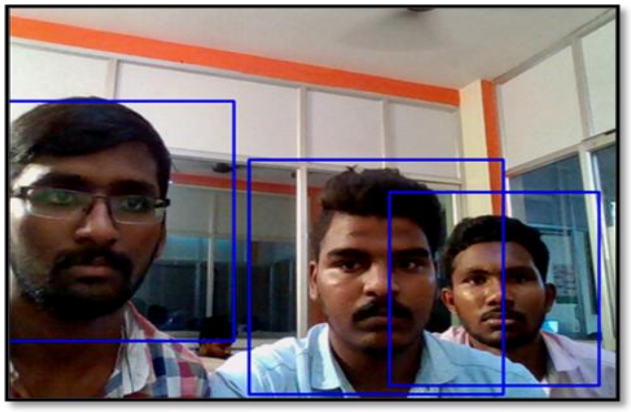

Fig 5. Classification of student faces

D. Output of Attendance Marking System

S.No	Roll Number	Student's Name	Attendance Time
1	922518106031	Dinakaran V	16:59:03
2	922518106005	Akilan R	16:59:03
3	922518106038	Gogul S	16:59:12

Fig 6. Automatic Attendance Marking System

After images are extracted from CNN features, the output of images is identified according to their individual image data set which was stored in the data base. The recognized images are plotted in Excel format and show their corresponding name with time of presence.

VII. CONCLUSION

In this work, we developed a sophisticated single-input, multiple-outputs attendance management system using facial recognition algorithms. This method eliminates the problems that come with traditional solutions. These methods are not advised since they are time-consuming and require each participant to enter the system separately to mark his or her attendance. In our work, we show an automated facial recognition attendance approach that comprises taking attendance by employing a camera in front of the classroom to get real-time photographs of the whole class, recognize the faces in the image, crop the image, and compare it to a database. A student is marked present once he or she has been identified. The method is performed several times to increase system efficiency, and the final results are recorded in an excel file. This automatic attendance system saves students' important study time because it runs in the background and requires little to no interaction from teachers or students. This method also reduces the likelihood of proxies and fake attendance. In today's culture, there are several biometric systems to choose from. Face recognition, on the other hand, is a viable option because of its high accuracy and minimal human engagement. This system's purpose is to give a high level of protection. In future, this proposed work is implementing in real time class room monitoring system with building a hardware components of notice board display and android application enabled in Smartphone instead of Desktop.

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