Face Recognition based Attendance System using CNN and Haar Classifier

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***Abstract*—Pakistan is the 5th country with the most population in the world. With the daily explosion of population and enhancement of mobility, the gridlock of traffic is often seen on the road. The gridlock of traffic reduces the efficiency of daily routine work by putting pressure on account of more fuel consumption and wastage of time. This is caused by signal failures or unprofessional ways of traffic management. Traffic management is the main attention to solve this problem. Many solutions were provided from which the techniques like video data analysis, wireless sensor network, infrared sensors, etc. that somehow solves the problem but it is too costly and time-consuming. The study has the objective to reduce traffic gridlock with the help of Internet of Everything Technology (IOE). IOE is the pattern of sense and response. Object detecting sensors can be used at traffic signals, direction boards, and streetlights to detect the presence of vehicles. RFID can be used to read the unique code from RFID tags attached at vehicles to detect the vehicle type. The data will be stored in the database using a network of connections. The data in graphical form can be perceived by Traffic Inspectors to judge the more gridlocked area and flow of traffic. In case of infringement of traffic rules, a fine will be charged. The engagement of this technique will be reliable, effective, and intelligible.**

***Keywords*—Convolution Neural Network, Attendance System, Feature Extraction, Vgg16, Deep Learning, Haar cascade classifier**

INTRODUCTION

Student attendance is the compolsury task of every class at every level of study. The old approaches of taking attendance is very limited and when the audience is huge, it is very typical control the attendacnce system accurately. Every organization must has their own attendance system. Biometric system of fingerprinting techniques has implemented in many ways but improvement must be required at all levels. New era tools have made many enhancements in the fluctuating world. Face recognition is one the system that can solve many problems in many areas of life. So here we can implement face recognition system for taking automatic attendance of students. Wearing a mask is necessary part of every day life after COVID19. So there must need a system that can fulfill every demand of accurate attendance system. A face recognition with face mask is shown in Fig 1.

Fig1: Face recognition with face mask [1]

There are lot of work already done related to face recognition using face mask during last two years after pandemic. Logmask [1] offers variety of work using AI on face mask recognition system. There system actually detect the perons with face and without face mask.

The normative structure of face recognition system and its techniques fail to handle different challenges like illumination, rotation, variations, pose, scaling and occlusions. The suggested background is intended to address the shortcomings of previous systems. Two or more cameras are required according to the size and need of the studyroom, must be mounted on the ceiling of the studyroom, from where they can view the whole area. The system will use the image obtained by these cameras as an input. Owing to the probability of image blurring due to student mobility, the image can be updated utilising Generative Adversarial Networks [2] for improved efficacy. For face detection, a newly created improved image will be sent to the system. Face recognition and feature extraction follow the face detection process. Convolutional neural networks are used to recognise faces. After the process of face recognition with the help of CNN algorithm, the system records the name and ID number of the present students of that particular class and whole process is completed. It will also generates ms-excel file which shows the name of students along their attendance. It also stores the current date and course name of that lecture. For basic system small hardware availability is enough but for larger records, GPUs are also required in the current system. FRAS system

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architecture is shown in Fig 2.

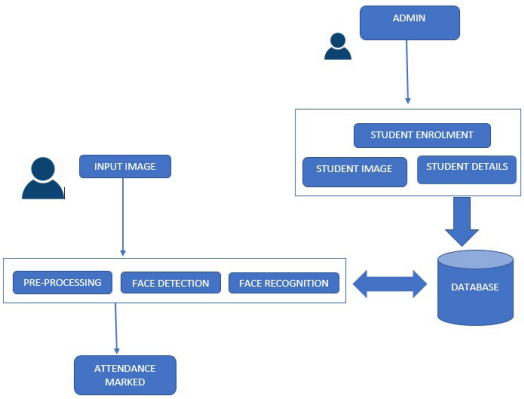

Fig 2: FRAS System Architecture

Above diagram shows the face recognition attendance system architecture. Firstly the system input the student image then pre-processing, face detection and face recognition steps are followed using Convolutional Neural Network. The system database stored the images of students with face mask and with out face mask along their bio-data with the help of admin panel. Everything is saved in a database every time a student's attendance is recorded.

LITERATURE REVIEW

Manually taking attendance used to be the norm, which grabbed a long time and usually caused human error. Moreover, there are many questions arise related to the attendance records, with the bulk of them not being retrieved from the actual scenario. The previous system of recording student attendance on paper sheets is no longer effective. According to the research, there are a variety of solutions for dealing with this issue [3]. Following are some famous and current face recognition methods applied in different organizations.

According to the study [4], the use of Near Field Cmmunication (NFC) along mobile application, improves the attendance system. In this system, NFC tag with a unique ID is allotted to every student when they enroll in the system. The teacher used his cell phone to record the attendance of each class by pressing or transferring these tags. The face of student will be taken by cell phone built-in camera, this image is moved to the main server of college for verification and validation. So NFC technology is very easy to use and speedy process but cell phone is required each time and this is one of the drawback of this system.

Another investigation [5] is based on the discovery of emotion recognition as a solution to the old attendance system's defects. Using a camera to record photographs of the employee, this technology detects and recognises faces. The captured image is match with the database record after the image is identified by the system. It compared each image of database to recognize the employee's face. The attendance is saved in to database. The key benefit of this system that attendance system data is highly secure and authorized persons are not allowed to access highly secure database Server [5]. Additionally, this approach can also be enhanced when using skin classification method to enhanced the accuracy of detection process. The problem is still remain that this approach of facial detection is not portable, it required desktop computer, continues power supply etc. This is only the incompitability of the system. Otherwise the accuracy level of this facial detection system is much better than previous systems.

Another study [6] focuses on the fingerprint recognition system, which employs two microcontrollers. A fingerprint sensor is used to obtain the fingerprint pattern, and then the information is delivered to microcontroller 1. After that, it sends the data to microcontroller 2 for database validation. The information is transmitted to the PC via serial communication and displayed after a student's match is discovered. This design is advantageous since it allows for faster development while maintaining design flexibility and making testing easier. The question of portability comes up again in this study.

The proposed method is essentially comparable to the first research magazine [4], which used RFID technology to improve an outdated attendance system, according to another research journal [7]. A tag label and a reader are used in this setup to trail the students' attendance once more. The difference between the first and this journals is that this one has a web site where you can get attendance information. It facilitates the retrieval of information. The RFID reader can only function when connected to a computer, hence this solution is also problematic in that it is not portable.

Several researchers have looked at the subject of face recognition. One existing method [8-9] used a face and facial recognition technique that combined structures derived from Discrete Cosine Transform (DCT) coefficients with a Contours and Weighted Distance Transform. The approach is tested in MATLAB and includes people with diverse facial expressions. Both performs well in their criteria. Following are the researches related to the method describe in this article. This Deep Learning facial recognition attendance system proposed by Arsenovic et al. [10]. This idea consists of different kinds mechanism that were constructed using CNN embedding and cascade generation cutting-edge method for the purpose of image detection. The system takes real images of company employees and achieved 95 percent accuracy. It will be very beneficial facial recognition technology for other different systems.

This approach Fu *et al*. [11] is the combination of Centre-face identification and Multi-task cascade convolution neural network (MTCNN), the two prominent deep learning algorithms. It was used to create an automatic attendance system for university classrooms. The main focus of this system to track classroom discipline, like late comings, leave class early by student and absent during class lecture. Following class, also generate the attendance table comprising of every student learning status. This face recognition system is lightning fast, lasting only 100 milliseconds per frame and get high accuracy 98.87 percent. It also get positive rate of less than 1/1000, and a false positive rate of 93.7 percent.

Zulfiqar et al. [12] suggested a convolutional neural network-based on face recognition system that employs the Viola-Jones [13] face detector to identify faces of an input image and then employs a pre-trained CNN to spontaneously extract facial features from those faces for recognition purpose. For comprehensive CNN trainings, a vast library of applicant facial photographs was established, and it was expanded to enhance the total number of shots per every applicant and deliver different lighting and noise circumstances [13]. Additionally, for deep learning face recognition system, an optimal fully trained CNN model and a conventional hyper-parameters along CNN were chosen experimentally. With an complete accuracy of 98.76 percent, the usefulness of deep learning facial recognition in an automatic biometric identification systems has been established in capable experimental findings.

CNN is a visual data analysis branch of the deep neural network. Yann LeCun came up with the idea for CNN in 1994 [14]. A Deep Learning system, CNN (Convolutional Neural Network) apply learnable weights and biases to different aspects on an input image, it also discriminate between them. The volume of pre-processing required by a Convolutional Neural Network is much less than that required by other classification methods. A CNN architecture is shown in Fig 3.

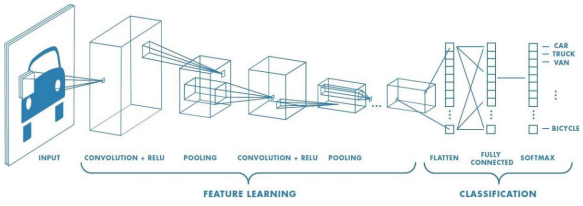

Fig 3: CNN Architecture [14]

K.Simonyan et al. [15] of Oxford University suggested in their article about the famous method of Convolutional Neural Network model called VGG16. This model achieves almost 92 percent accuracy by using famous database ImageNet. This ImageNet database is consisting of over 14 million images and that are belonging to 1000 plus classes. This model is very famous and it overtakes AlexNet by taking kernel size filters (11 and 5 in different layers of CNN. It also takes maximum 33 kernal size filters in a sequential manner. VGG16 had been training on NVIDIA Titan Black GPUs for weeks. A VGG network is shown in Fig 4.

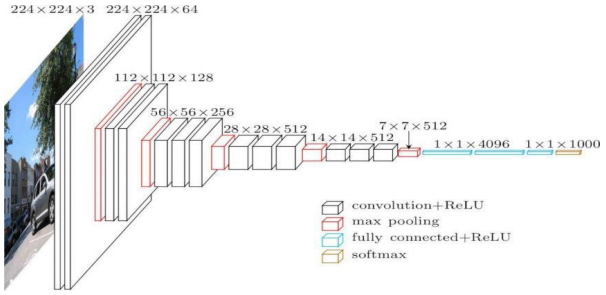

Fig 4: VGG16 Architecture [15]

PROPOSED METHOD

Face recognition system will follow some mechanism to complete the task and for the successful completion of Attendance system, following steps will be taken.

Database Creation

The database will be built in the first phase, at the time of student enrolling. Students' generic information, such as their name, identification number, course, and semester subjects, will be saved in the database. The system will also capture the image of the student for the suggested system's training. For training purposes, this system records a single image for each pupil. Facial recognition of every student attending a lecture using all of the photographs the student has stored in the database. The system uses Django framework for the database creation and handling as shown in Fig 5.

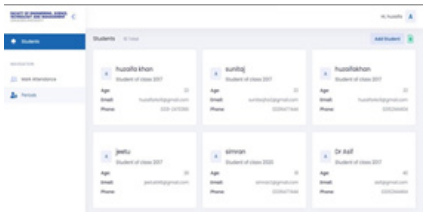

Fig 5: Django framework for Database

Face Detection

Face detection is based on a total of 68 facial landmarks. Faces are recognised with the help of these landmarks. Haar classifiers were employed for facial detection [16]. The cascade function is trained from a huge number of negative and positive images and it follows machine learning methodology. This is then applied to other photos in order to detect them. These classifiers are just the total amount of pixels in the dark area subtracted from the total of pixels in the white area. It was discovered that applying 6000 characteristics to each window frame was tough. Features were organised into phases, which are referred to as classifier

cascades.

Feature Extraction

CNN filters are used to hang on to face characteristics that are inclined at various degrees for feature extraction. It's a crucial stage because it's thought that a successful feature extractor chooses a function that's immune to occlusion, illumination, context, and position variation. Filters are used to improve spatial misrepresentation after the variation in position and lighting.

Face Recognition

Convolutional neural networks were utilised to recognise faces. The accuracy, robustness, and time complexity of this approach are compared. Convolutional Neural Networks permit us to extract multiple range of features from photos. This method of extracting face recognition functionality can also be applied. CNN generates 128 different dimensional encodings, consists of facial landscapes in the format of RGB, using 68 facial landmarks. To match faces, these encodings are compared. The degree to which a face comparison is stringent can be controlled by the tolerance value. [17].

FRAS based face recognition with and without mask is shown in Fig 6.

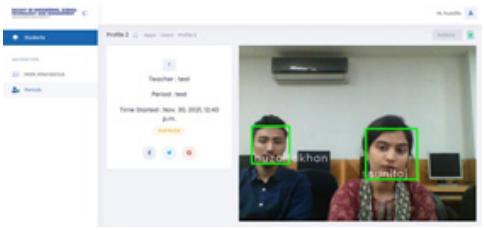

Fig 6: FRAS Face Recognition without mask

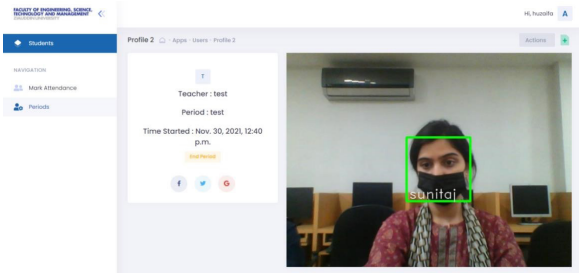

Fig 7: FRAS Face Recogniton with mask

Report Generation

During a lecture, in excel format, putting attendance against name of the student and enrolment number produces trailing facial recognition results. Fig 7 also shows that FRAS can work on face mask too. This is the basic efficiency of FRAS algorithm. Attentance marked in database is shown in Fig 8 and list of student attendance is shown in Fig 9. That achieve the face recognition criteria in better way.

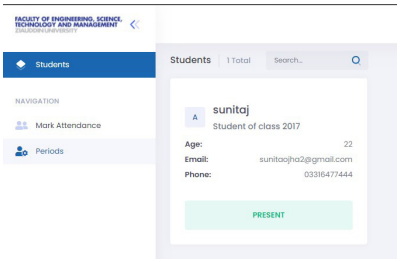

Fig 8: Attendance marked in Database

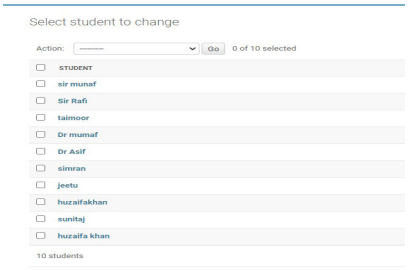

Fig 9: List of Students Attendance

The Proposed method is compared with the latest researches [18-19] according to accuracy and F1-score. Following results are calculated after the comparison.

CONCLUSION AND FUTURE WORK

Table1: Comparison of proposed method with HOG-CNN and Deep Net

Researches	Methods	Accuracy	F1-score
Proposed	CNN	0.96	0.55
Hung B. T. (2001)	HOG-CNN	0.95	0.64
Gwyn et al. (2001)	Deep Net	0.84	0.5

This system presents a more efficient technique of attendance in the classroom, which can replace the outdated manual methods. This method is sufficient in terms of security, reliability, accuracy, and efficiency. Installing the system in the classroom does not require any specialised hardware. It can be made with a camera and a computer. To boost the system's performance, some algorithms that can distinguish faces in veil must be used.

Almost all academic institutions need students to keep track of their attendance, and keeping track of attendance manually can be a time-consuming and stressful endeavour. As a result, keeping attendance automatically with the use of face recognition will be extremely beneficial and error-free as

compared to a manual procedure. This will also decrease student manipulation of attendance records while also saving time. The suggested work's future scope could include collecting many detailed photographs of the kids and storing these images utilising any cloud technology. To identify fraud, the technology can be designed and deployed in ATM machines. Additionally, the technique can be utilised during elections to identify voters by identifying their faces.

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