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AI PRESENT: RANDOM INTERVAL QUERY AND FACE RECOGNITION ATTENDANCE SYSTEM FOR VIRTUAL CLASSROOM USING MACHINE LEARNING

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ABSTRACT

The COVID-19 pandemic outbreak has resulted in an unprecedented crisis across the globe. The pandemic created an enormous demand for innovative technologies to solve crisis-specific problems in different sectors of society. In the case of the education sector and allied learning technologies, significant issues have emerged while substituting face-to-face learning with onlinevirtual learning. Several countries have closed educational institutions temporarily to +alleviate the COVID-19 spread. The closure of educational institutions compelled the teachers across the globe to use online meeting platforms extensively. The virtual classrooms created by online meeting platforms are adopted as the only alternative for face – to-face interaction in physical classrooms.

In this regard, students' attendance management in virtual classes is a major challenge encountered by the teachers. Student attendance is a measure of their engagement in a course, which has a direct relationship with their active learning. However, during virtual learning, it is exceptionally challenging to keep track of the attendance of students. Calling students' names in virtual classrooms to take attendance is both trivial and time-consuming. Thus, in the backdrop of the COVID-19 pandemic and the extensive usage of virtual meeting platforms, there is a crisis-specific immediate necessity to develop a proper tracking system to monitor students' attendance and engagement during virtual learning.

KEYWORDS: Artificial Intelligence

INTRODUCTION

A virtual classroom is an online teaching and learning environment where teachers and students can present course materials, engage and interact with other members of the virtual class, and work in groups together. The key distinction of a virtual classroom is that it takesplace in a live, synchronous setting. Online coursework can involve the viewing of pre-recorded, asynchronous material, but virtual classroom settings involve live interaction between instructorsand participants.

Virtual classrooms and distance learning, as alternate technology-driven learning methods, have been growing at a reasonable pace. Virtual classrooms have been specifically in use by all sectors, including primary and higher education as well as corporate learning. The increasing popularity of social and microlearning strategies, fostered by general social media platforms like YouTube and Twitter, and major educational technology disruptions like edX, have added to the increasing acceptance of virtual modes of learning. It is expected that the predominant use of virtual classrooms would increase by a whopping 16.2% compounded annualgrowth rate by 2023. Nevertheless, virtual classrooms have not yet been considered as a serious alternative or substitute for the contemporary face-to-face (F2F) learning.

DOMAIN OVERVIEW

Zoom, Google Meet, Microsoft Teams, and Cisco WebEx Meetings are used to create virtual classrooms. Manual attendance calling, self-reporting attendance systems (using tools like Google forms), video calling students, short quizzes or polls, questions and discussions by selecting random students, and timed assignments. In the case of physical classrooms, biometric-based attendance monitoring systems are based on face, fingerprint, and iris recognition technologies Facial recognition is a technology that can recognize a person based on their face. It employs machine learning algorithms which find, capture, store, and analyses facial features to match themwith images of individuals in a pre-existing database. Early approaches focused on extracting different types of hand-crafted features with domain experts in computer vision and training effective classifiers for detection with traditional machine learning algorithms. Such methods are limited in that they often require computer vision experts in crafting effective features, and each individual component is optimized separately, making the whole detection pipeline often sub-optimal. There are many existing FR methods that achieve a good performance.

(i). Principal Component Analysis (PCA)

One of the most used and cited statistical method is the Principal Component Analysis. A mathematical procedure performs a dimensionality reduction by extracting the principal component of multi-dimensional data. Principal component analysis id reducing theEigen value and Eigen vectors problem in a matrix. Simply Principal component analysis is used for a wide range of variety in different applications such as Digital image processing.

(ii). Linear Discriminant Analysis (LDA)

LDA is widely used to find the linear combination of features while preserving class separability. Unlike PCA, the LDA tries to model to the difference between levels. For each level the LDA obtains differenced in multiple projection vectors. Linear discriminant analysis method is related to fisher discriminant analysis. Linear discriminant analysis is using to describing the local features of the images. Features are extracting the form of pixelsin images; these features are known as shape feature, color feature and texture feature. The linear discriminant analysis is using for identifying the linear separating vectors between features of the pattern in the images. This procedure is using maximization between class scatter, when minimizing the intra class variance in face identification.

(iii). Neural Network (NN)

Neural Network has continued to use pattern recognition and classification. Korhonenwas the first to show that a neuron network could be used to recognize aligned and normalized faces. There are methods, which perform feature extraction using neural networks. There are many methods, which combined with tools like PCA or LCA and makea hybrid classifier for face recognition. These are like Feed Forward Neural Network with additional bias, Self-Organizing Maps with PCA, and Convolutional Neural Networks with multi-layer perception, etc. These can increase the efficiency of the models.

EXISTING SYSTEMS

Proposed System of the project introduces the novel feature of randomness in ani-based face recognition system to effectively track and manage students' attendance and engagement in virtual classrooms. Enhances the efficacy of the attendance management in virtual classrooms by integrating two ancillary modalities students' real-time response to CAPTCHAs, Concept QA and UIN (Unique Identification Number) queries. Monitors students' attendance and engagement during virtual learning without affecting their focus on learning. Proposed two ancillary modalities - verifying students' responses to Subjects and UIN (Unique Identification) queries at random intervals of time.

PROPOSED SYSTEM & MODULES

DCNN

CNNs are a category of Neural Networks that have proven very effective in areas such as

Image recognition and classification. CNNs are a type of feed-forward neural networks made up of many layers. CNNs consist of filters, kernels, or neurons that have learnable weights or parameters and biases. Each filter takes some inputs, performs convolution and optionally follows it with a non-linearity. A typical CNN architecture can be seen as shown in Fig.1. The structure of CNN contains Convolutional, pooling, Rectified Linear Unit (ReLU), and Fully Connected layers.

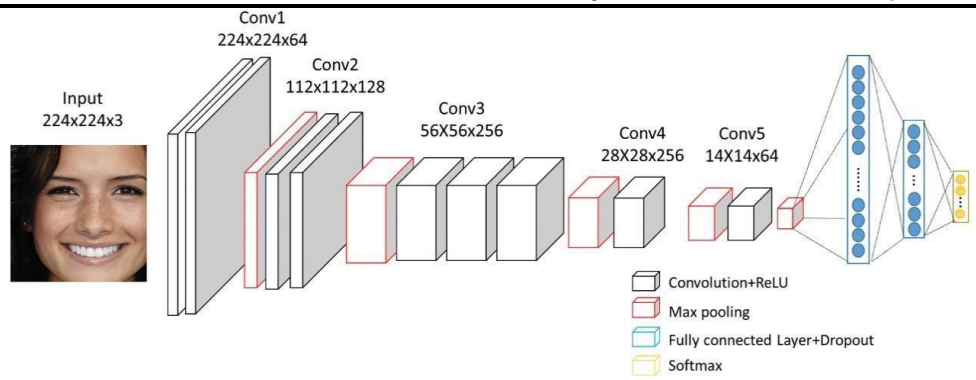


Fig.1 The Structure of CNN

Convolutional Layer: Convolutional layer performs the core building block of a Convolutional Network that does most of the computational heavy lifting. The primary purpose of Convolution layer is to extract features from the input data which is an image. Convolution preserves the spatial relationship between pixels by learning image features using small squares of input image. The input image is convoluted by employing a set of learnable neurons. This produces a feature map or activation map in the output image and after that the feature maps are fed as input data to the next convolutional layer.

MODULE DESCRIPION

(i). Virtual meet

In this module we are going to develop virtual meet API. A virtual meet API is a video conferencing tool where instructors and participants engage with each other and with the learning material. The interface between AI Present and virtual meeting platforms are facilitated through a web interface that runs on the teachers and students' smart devices in master and slave modes, respectively. The faculty, as well as students, should log in to the online learning platform with their smart devices. The web interface page should remain active during the entire course of the class. Here, the web interface at the teachers' smart device facilitates two things.

(ii).AI Present Module

- **Enrollment Phase**

Student Databases Server maintained in this system are student information database, face database and attendance database. Student information database consists ofroll number, name and class of student. Attendance database includes attendance status ofstudent for every day. The face database consists of face images of student's according totheir roll numbers.

- **Face Image Acquisition-**

This module is initial part of the system. Logitech C270 (3MP) is used for imageacquisition.

- **Preprocessing**

The acquired images are converted to grayscale image and then resize. After the removal of noise using mean and Gaussian filters all further operations are performed on this image.

- **Face Detection**

After capturing the image, the image is given to face detection module. This module detects the image regions which are likely to be human. Face detection purpose, Region Proposal Network (RPN) draws anchors and outputs the one which contains the objects. The detected face regions are cropped and scaled to 200x200resolution and then used for further recognition task.

- **Feature Extraction**

After the face detection, face image is given as input to the feature extraction module to find the key features that will be used for classification.

- **Feature Classification**

The module composes a very short feature vector that is well enough to represent the face image. Here, it is done with DCNN method. Then the classified result is stored into the database.

- **Attendance System**

After the verification of faces and successful recognition is done, the attendanceof the student is marked in front of his/her roll number. If the face is not recognized, an error page is displayed. It involves the attendance report generation. The module takes student information and daily attendance status from student database. The attendance is

calculated as per requirement. There are options for calculating day-wise, student wise and class-wise attendance. The attendance reports are generated and saved in a file.

- **Learning Attentive Prediction:**

To improve the efficiency of the classroom learning attentive, we introduced two ancillary modalities – verifying students' responses to Concept QA and UIN (Unique Identification Number) queries. This distinctive feature of randomness in our design ensures that students' attention and engagement in virtual learning are enhanced. The efficiency of the proposed system is improved by introducing students' responses to Concept QA (P2) that pop-up k2-times in the students' device at random intervals. Also, the students must enter their UIN k3-times (P3) when they are directedto do it randomly. The random intervals of time are designed in such a way that it followsthe attention span distribution of the students.

STUDENT MANAGEMENT

In this module, institute can enroll students to the college after counselling.

J Manage personal details, assign class, roll number and generate ID cards to the students.

- Student profile with photo and documents
- Parents & Guardian details
- Id card and certificate

Detailed profile & progress tracking

- Progress report

HR & STAFF MANAGEMENT

Manage HRM activities of the college including registering technical / non- technical staff, manage staff designations, personal details and professional details, generate ID cards, staff performance analysis and appraisals.

- Staff records
- Staff attendance
- Leave Management
- Payroll and salary
- Reimbursement
- Promotion/Transfer

ACADEMIC MANAGEMENT

- Timetable
- Lesson Planning
- Lesson Progress tracking
- Classwork & Homework
- Exam Management
- Progress report

LEARNING MANAGEMENT

- Organized content Sharing
- Live Classes
- Assignments
- Live Class Hosted by Faculty/AP/HOD through Faculty/AP/HOD Panel.
- Live Class Join by Student through Student Panel.
- Social Media Streaming.
- Host up to 100 participants.
- Faculty/AP/HOD Can upload Study Material, Syllabus, Assignment, Homework indifferent file type including videos also.
- Student Can Upload their Homework in Portal.
- Improve Accountability.
- Parents can easily keep track of all their student's homework in one place.

COMMUNICATION

- Notes/announcements
- Events & activities
- Schedules
- Achievements
- Birthday greeting
- Academic Calendar
- Holiday updates

ATTENDANCE MANAGEMENT

Student attendance management enables easy tracking attendance information of students. Generate quick attendance reports with class wise analysis, monthly analysis and yearly analysis. There is also provision for Faculty/AP/HODs to take attendance withan Android based phone or tablet.

Staff attendance module maintain quick and accurate recording of staff attendance and automatically calculate the total leaves, pending leaves, working days. Various typesof leaves/absences/late comings can be marked for employees. By using this module, school management can easily record the regularity and punctuality of each employeeincluding late coming, early going and can determine salary payable efficiently.

- Subject/class wise attendance
- Attendance through App/web
- Attendance reports
- Absent/present SMS alert
- Lecture wise Attendance

REPORTS & ANALYSIS

- 100+ Custom reports
- Exam & Attendance reports
- User data reports
- Fees reports
- Inquiry reports
- Staff & HR reports

END USER

- Admin This module is handled by top management to create role wise user logins to staffs accessing College management ERP System. Admin can generate notificationsfor students and staff; send SMS, emails, reminders time to time. Here Admin can add/update/delete student/employee/courses, view course list/student list or many different modules.
- Student Here Student can view profile, task, class schedules, exam report card, attendLive Class Session
- Teaching Staff Faculty/AP/HOD can view profile, add task, exam reports, schedules.Here, they will be able to access the information of Students Profile, his detailed Feesaccount, his Term wise and Daily attendance and his appraisal report i.e., result statement along with the comparative graphical analysis – Term wise and Subject wise, which enables them to get evaluate the students' performance in the Class and last but not the least his performance in various Co-curricular activities organized in the Institution

SMS/EMAIL FACILITY

Here Facility to send SMS/Email like Class Schedule, Fees Payment/Attendance/Exam, Meetings, Seminars etc.to Students, Parents/Guardians,Employees, management etc.

PERFORMANCE COMPARISON: There are various parameters with the help of which one can measure the performance of any biometric authentication techniques. These factors are described below.

False Accept Rate (FAR) or False Match Rate (FMR): The probability that the system incorrectly declares a successful match between the input pattern and a non-matching pattern in the database. It measures the percent of invalid matches. These systems are critical since they arecommonly used to forbid certain actions by disallowed people.

False Reject Rate (FRR) or False Non-Match Rate (FNMR): The probability that the system incorrectly declares failure of match between the input pattern and the matching template in the database. It measures the percent of valid inputs being rejected.

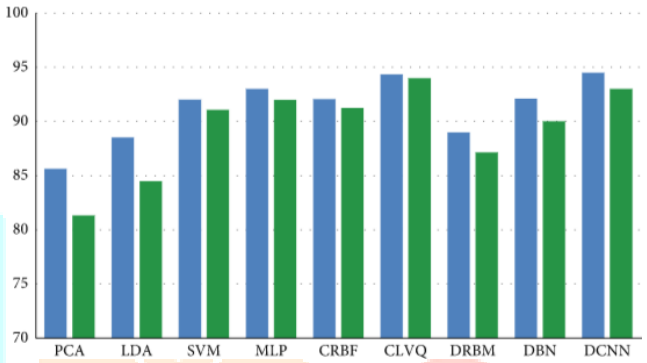
Equal Error Rate (EER): The rates at which both accept and reject errors are equal. ROC or DET plotting is used because how FAR and FRR can be changed, is shown clearly. When quick comparison of two systems is required, the ERR is commonly used. Obtained from the ROC plotby taking the point where FAR and FRR have the same value. The lower the EER, the more accurate the system is.

Failure to Enroll Rate (FTE or FER): The percentage of data input is considered invalid and fails to input into the system. Failure to enroll happens when the data obtained by the sensor are considered invalid or of poor quality.

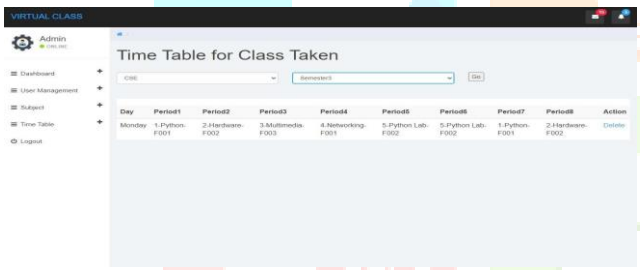
Failure to Capture Rate (FTC): Within automatic systems, the probability that the system fails to detect a biometric characteristic when presented correctly is treated as FTC.

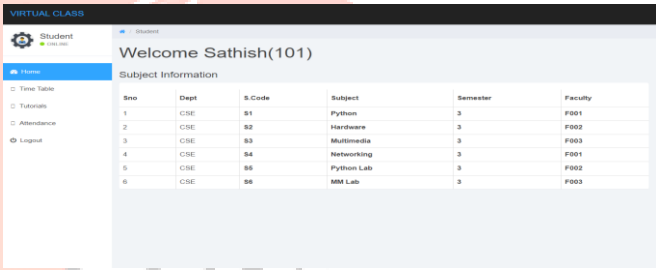
RESULTS AND DISCUSSION

This section provides the results of the experimental procedures carried out while realizing the AI Present prototype model. Specific results obtained by implementing the AI Present face recognition module and the ancillary modalities are critically discussed. The results from the face recognition module are discussed in accordance with its training and testing phases. Face recognition can be regarded as successful if at least one of the five training samples matches with the test sample. Thus, if the test images extracted from the video frames of the virtual class are matching with the training samples, attendance from the face recognition moduleis recorded. A comparative evaluation based on the accuracy of the proposed face recognition Deep Convolutional Neural Network (DCNN) system, compared to Support Vector Machine (SVM), Linear Discriminant Analysis (LDA), Principal Component Analysis (PCA), as statistical approach, Multi-Layer Perceptron (MLP), Combined Radial Basis Function (CRBF), as neural network approach, Deep Restricted Boltzmann Machine (DRBM), Deep Belief Neural Nets (DBNN).The results show that the proposed DCNN achieves higher accuracy compared to other approaches.

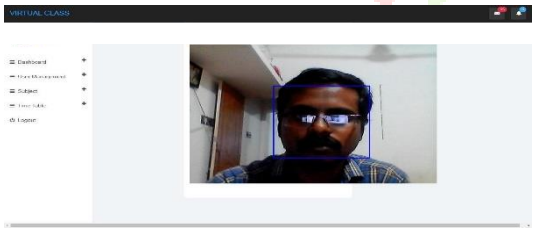


Face Recognition Accuracy

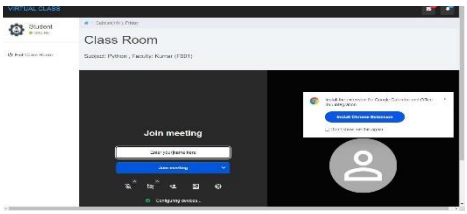




SYSTEM IMPLEMENTATION



SYSTEM CHECK



SYSTEM TESTING

CONCLUSION

Random Interval Attendance Management System (AI Present) is an innovation based on Artificial Intelligence – Deep Learning, specially designed to help the teachers/instructors across the globe for effective management of attendance during virtual learning. AI Present facilitates precise and automatic tracking of students' attendance in virtual classrooms. It incorporates a customized face recognition module along with specially designed ancillary submodules. Both the face recognition and the sub modalities are for students' attendance monitoring in virtual classrooms. The submodules check students' responses to CAPTCHAs, Concept QA and UIN queries. The system captures face biometric from the video stream of participants and gathers thetimely responses of students to Concept QA and UIN queries, at random intervals of time. An intelligible and adaptive weighting strategy

is employed for finalizing the decisions from the three modalities. AI Present could be integrated with any existing virtual meeting platform through an application interface like a web page or a specific App.

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