RANDOM AUTO QUERY AND FACE RECOGNITION ATTENDANCE SYSTEM FOR VIRTUAL MEET USING DEEP LEARNING

A PROJECT REPORT

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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 online virtual 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. 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. In this project, we are addressing the pandemic-induced crucial necessity by introducing a novel approach. In order to realize a highly efficient and robust attendance management system for virtual learning, we introduce the Random Interval Query and Face Recognition Attendance Management System (hereafter, AI Present). To the best of our knowledge no such automated system has been proposed so far for tracking students' attendance and ensuring their engagement during virtual learning.

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF ABBREVATION

ABBREVATION	EXPLANATION
UNO	United Nations Organisation
WHO	World Health Organization
AI	Artificial Intelligence
ML	Machine learning
DL	Deep learning
IoT	Internet of Things
OCR	Optimal character recognition
DARPA	Defense Advanced Research Projects Agency
CNN	Convolutional Neural Networks
RIAMS	Regulatory Information and Management Systems
UIN	Unique Identification Number
AMM	Attendance management method
OAMS	Online Attendance Monitoring System
QR	Quick Response
VFR	Video-based face recognition
SVM	Support Vector Machine
LBP	Liner Binary Pattern
HOG	Histogram of Oriented
CBSA	Canadian Business and Current Affairs
DNN	Deep Neural Networks
REID	Radio Frequency Identification Detect
RTC	Real Time Clock

LCD	Liquid-crystal display
GSM	Global System for Mobile communication
KNN	K-Nearest Neighbors
FR	Face Recognition
FCL	Fully Connected Layer
RGB	Red Blue Green
RPN	Region Proposal Network
RG	Region growing
GLCM	Gray Level Co-occurrence Matrix
GLRLM	Gray level run length matrix
GLDM	Gray level dependence matrix
NGTDM	Neighbouring Gray tone difference matrix
GLSZM	Gray level size zone matrix
LRN	Local response normalization
SMS	Short message service
FC	Fully-connected
DFD	Data Flow Diagrams
UML	Unified Modeling Language
PCA	Principal Component Analysis
NN	Neural Network
GPL	General Public License

CHAPTER 1
INTRODUCTION

1.1. Overview

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 takes place in a live, synchronous setting. Online coursework can involve the viewing of pre-recorded, asynchronous material, but virtual classroom settings involve live interaction between instructors and 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 annual growth 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.

Things have started to look different, however, in the wake of the current, novel coronavirus COVID-19 pandemic, since the entire world is under lockdown. It is the time of the year when academic and teaching activities are in full swing in most parts of the world. The current pandemic situation has paved the way for a ground test of virtual classrooms as a prominent tool of learning in the current times. Schools, colleges, universities, corporates, and even world bodies and multilateral

organizations like the UNO, WHO, and G20 have had to switch to the lesser-used virtual mode of learning and communications. These emergent circumstances stand as a conducive test for companies offering virtual classroom platforms and services like Blackboard, Desire2Learn, Cisco, Microsoft, etc. The test parameters are varied, some predominant ones being bandwidth management, network traffic, server response time, and a number of concurrent users.

A virtual classroom includes the following features:

- **Video conferencing:** using the best web conferencing software to facilitate learner-teacher-learner communication
- **Digital whiteboards:** offering real-time demonstrations and diagrams
- **Instant messaging**: allowing typed conversations on lower bandwidths
- **Participation controls**: enabling students to participate in discussions, mute their surroundings or virtually "raise" their hands
- **Sub-chats:** breakout rooms to facilitate collaboration between learners
- **Video recording:** to save live lectures as video-on-demand for later reference
- **End-to-end encryption:** to ensure virtual classroom access is restricted to authorized learners

1.1.1. Types Of Virtual Classrooms That Are Learner-Friendly

Virtual classrooms can be tweaked depending on the use required of them. They may feature as an add-on in a course or form the backbone of an entire course; either way, virtual classrooms are highly customizable.

- **Enriched virtual type**

The majority of the course is carried out online, save for a few offline components to augment lessons and curricula. These components are most popularly in the form of face-to-face meetings with instructors or collaborative meetings with fellow learners over a critical assignment or thesis.

- **Rotation type**

Often used as part of the flipped classroom technique, rotation involves using both virtual and offline classrooms on rotation according to a schedule. In many cases, primary learning happens online, while in-person meetings happen for reinforcement and review.

- **Fully online type**

As the name suggests, a fully online classroom doesn't require or allow for face-to-face offline interactions. These course types could be synchronous or asynchronous in that they use pre-recorded videos and minimal live interaction through online meeting software.

- **Flexible type**

The virtual classroom remains open and available for students to access at times convenient to them. Otherwise, learning is encouraged through small groups, with the virtual classroom forming a place to return to in case of questions.

- **Mix-and-match type**

As the name suggests, this model allows students to select a method that works best for them, such that they gain maximum knowledge. It is a combination of digital teaching models and can either be student-led or institution-governed.

1.2. Problems Identified

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 online virtual learning. The existing structures and processes of face-to-face learning have been disrupted because of the unforeseen situation that emerged out of COVID-19. Owing to the mandatory social distancing compelled by the pandemic, the standard operating mode of educational institutions around the world has changed into virtual mode significantly. 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. Subsequently, online meeting platforms like Zoom, Google Meet, Microsoft Teams, and Cisco Webex Meetings are used to create virtual classrooms. Educational institutions, teachers, and students are finding more advantages in using virtual learning that were not previously popular. On the other hand, researchers have identified several challenges associated with the widespread use of virtual learning, which is characterized by quite a lot of interrelated features pertaining to students, teachers, and the technologies involved.

Due to the inherent characteristics of virtual learning, students may resort to unethical activities like not attending the class but still keeping their status as `online'. Moreover, any student can go offline at any time without letting the teacher know. Further, it is not easy to find out whether the student is really attending the class or just being online without paying attention. In this case, teachers may not be able to check whether the student is actually present and paying attention to the class, as the student might have turned off the video camera.

Cheating prevention during online assessments is complicated

Unfortunately, one of the biggest disadvantages of E-Learning continues to be cheating through various methods. Compared to on-campus students, online students can cheat on assessments more easily as they take assessments in their own environment and while using their personal computer. The students cannot be directly observed during assessments without a video feed, making cheat detection during online assessments more complicated than for traditional testing procedures. Additionally, without a proper identity verification system in place, students taking

online assessments might be able to let a third party take the assessment instead of themselves, resulting in a wholly fraudulent test result.

E-Learning lacks face-to-face communication

The lack of face-to-face communication ties together with many of the previously mentioned disadvantages of online learning. A lack of any kind of face-to-face communication with the instructor inhibits student feedback, causes social isolation, and could cause students to feel a lack of pressure. A lack of pressure is a disadvantage in the sense that it causes students to abandon their studies more easily. Constant nudging by professors may be undesirable for many, but it's an effective method for improving student retention.

Student engagement

One challenge of virtual learning is that there is an increased responsibility on the learner to manage their focus and time spent on course material. It's easy to get distracted when the internet is at your fingertips. On top of that, every learner is different; some prefer visual learning, while others retain information through auditory or kinaesthetic learning methods. Presenting subject matter in a content format that doesn't fit students' learning style can impede their engagement and knowledge retention.

Online student feedback is limited

In traditional classrooms, teachers can give students immediate face-to-face feedback. Students who are experiencing problems in the curriculum can resolve them quickly and directly either during the lecture or during the dedicated office hours. Personalized feedback has a positive impact on students, as it makes learning processes easier, richer, and more significant, all the while raising the motivation levels of the students.

E-Learning, on the other hand, still tends to struggle with student feedback. Students completing regular assessments become dissatisfied when they

experience a lack of personalized feedback. The traditional methods of providing student feedback don't always work in an E-Learning environment, and because of this, online education providers are forced to look towards alternative methods for providing feedback. Providing student feedback in an online setting is still a relatively unresearched topic area, and it might take a while for any specific strategies to become fully research-based and proven to be effective. 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.

1.3. Artificial Intelligence

Artificial Intelligence (AI) is the field of computer science dedicated to solving cognitive problems commonly associated with human intelligence, such as learning, problem solving, and pattern recognition. Artificial Intelligence, often abbreviated as "AI", may connote robotics or futuristic scenes, AI goes well beyond the automatons of science fiction, into the non-fiction of modern-day advanced computer science.

Professor Pedro Domingo's, a prominent researcher in this field, describes "five tribes" of machine learning, comprised of symbolists, with origins in logic and philosophy; connectionists, stemming from neuroscience; revolutionaries, relating to evolutionary biology; Bayesians, engaged with statistics and probability; and analogizes with origins in psychology. Recently, advances in the efficiency of statistical computation have led to Bayesians being successful at furthering the field in a number of areas, under the name "machine learning". Similarly, advances in network computation have led to connectionists furthering a subfield under the name "deep learning". Machine learning (ML) and deep learning (DL) are both computer science fields derived from the discipline of Artificial Intelligence.

Broadly, these techniques are separated into “supervised” and “unsupervised” learning techniques, where “supervised” uses training data that includes the desired output, and “unsupervised” uses training data without the desired output.

AI becomes “smarter” and learns faster with more data, and every day, businesses are generating this fuel for running machine learning and deep learning solutions, whether collected and extracted from a data warehouse like Amazon Redshift, ground-trothed through the power of “the crowd” with Mechanical Turk, or dynamically mined through Kinesis Streams. Further, with the advent of IoT, sensor technology exponentially adds to the amount of data to be analyzed -- data from sources and places and objects and events that have previously been nearly untouched.

1.3.1. History of AI

The history of artificial intelligence goes as far back as ancient Greece. However, it’s the rise of electronic computing that made AI a real possibility. Note that what is considered AI has changed as the technology evolves. For example, a few decades ago, machines that could perform optimal character recognition (OCR) or simple arithmetic were categorized as AI. Today, OCR and basic calculations are not considered AI but rather an elementary function of a computer system.

1.3.2. AI in everyday life

Below are some AI applications that you may not realize are AI-powered:

Online shopping and advertising

Artificial intelligence is widely used to provide personalized recommendations to people, based for example on their previous searches and purchases or other online behavior. AI is hugely important in commerce: optimizing products, planning inventory, logistics etc.

Web search

Search engines learn from the vast input of data, provided by their users to provide relevant search results.

Artificial intelligence against Covid-19

In the case of Covid-19, AI has been used in thermal imaging in airports and elsewhere. In medicine it can help recognize infection from computerized tomography lung scans. It has also been used to provide data to track the spread of the disease.

Fighting disinformation

Certain AI applications can detect fake news and disinformation by mining social media information, looking for words that are sensational or alarming and identifying which online sources are deemed authoritative.

1.3.3. Deep Learning

Deep Learning is a branch of machine learning that involves layering algorithms in an effort to gain greater understanding of the data. The algorithms are no longer limited to create an explainable set of relationships as would a more basic regression. Instead, deep learning relies on these layers of non-linear algorithms to create distributed representations that interact based on a series of factors. Given large sets of training data, deep learning algorithms begin to be able to identify the relationships between elements. These relationships may be between shapes, colors, words, and more. From this, the system can then be used to create predictions. Within machine learning and artificial intelligence, the power of deep learning stems from the system being able to identify more relationships than humans could practically code in software, or relationships that humans may not even be able to perceive. After sufficient training, this allows the network of algorithms to begin to make predictions or interpretations of very complex data.

Image and Video Classification, Segmentation

Convolutional Neural Networks out-perform humans on many vision tasks including object classification. Given millions of labeled pictures, the system of algorithms is able to begin identifying the subject of the image. Many photo-storage services include facial recognition, driven by Deep Learning.

1.4. Scope of the project

In order to realize a highly efficient and robust attendance management system for virtual learning, this project introduce the Random Interval Attendance Management System (hereafter, AIPresent). To the best of our knowledge no such automated system has been proposed so far for tracking students' attendance and ensuring their engagement during virtual learning. The proposed method is the simplest and the best approach to automatically capture the attendance during virtual learning. The significance of the AIPresent model is that it precisely monitors attendance in virtual classrooms without hindering the learning process. Further, it can generate dedicated attendance reports, pinpointing students' attention during virtual learning at random time intervals. Moreover, the novel random attendance tracking approach can also prevent the dropping out of participants from the virtual classroom. Randomness ensures that students cannot predict at which instant of time the attendance is registered.

Another added advantage of the RIAMS approach is that it requires only nominal internet bandwidth in comparison with the existing face recognition-based attendance tracking systems. AIPresent is in such a way that it does not affect the learning process in any way. Neither the students nor the teachers will have to face any difficulties in virtual classrooms with the AIPresent design. As the random intervals required for executing AIPresent attendance tracking modalities are too short (30 seconds, or less), the teaching-learning process is not affected. The

proposed model can be easily scaled and integrated into a wide variety of virtual meetings, including business meetings.

1.5. Objective

The key objective of AIPresent is to develop a robust system that monitor students' attendance and engagement in a virtual classroom, at random intervals of time. It encompasses a novel design using the AI Deep CNN (Convolution Neural Network) model to capture face biometric randomly from students' video stream and record their attendance automatically. Thus, the main component of the proposed model is a face recognition module built using the AI-DL tools. RIAMS also incorporates ancillary submodules for assessing students' responses to CAPTCHAs and UIN queries, to ensure active engagement in virtual classrooms.

CHAPTER 2

LITERATURE SURVEY

1. A Student Attendance Management Method Based on Crowdsensing in Classroom Environment

Author: Zhigang Gao; Yucai Huang; Leilei Zheng; Xiaodong Li; Huijuan Lu; Jianhui Zhang; Qingling Zhao; Wenjie Diao; Qiming

Year: 2021

Link: https://ieeexplore.ieee.org/document/9356601

Objective

This paper presents a student attendance management method that combines the active reporting and sampling check of students' location information, which has the advantages of high real-time performance and low disturbance.

Methodology

The author proposes an intelligent attendance management method named AMMoC. AMMoC need neither deploy additional hardware devices in the classroom, nor collect the biological characteristics of students. AMMoC only needs to install two Android applications on mobile devices of teachers and students respectively, and uses mutual verification between students to complete attendance checking. AMMoC divides the classroom into several subregions, and assigns students to verify the student number of subregions. The verification process is classified into a series of crowdsensing tasks. At the beginning of attendance checking, students submit their location information to AMMoC within a time limit. After AMMoC obtains the location information of students, it uses an algorithm based on intelligent search, selects several students to complete the crowdsensing tasks which require to submit the number of students of a specific subregion, etc.

AMMoC will analyze the truth of the initial location information based on the results of the crowdsensing tasks submitted by the students.

Limitation

Plan to shift the attendance checking scene into the virtual one in order to extend the on-site classroom attendance checking to the attendance checking in the online learning environment. Hope to achieve continuous non-disturbance attendance checking in order to be suitable for the applications of multiple learning scenarios.

Conclusion

AMMoC will analyze the truth of the submitted locations based on the student number of subregions submitted by the verifiers. The experiment results show that the AMMoC has the advantages of short attendance checking time and high accuracy. Therefore, it is suitable for AMMoC to perform attendance checking in a classroom environment.

2. Online Attendance Monitoring System Using QR Code (OAMS)

Author: Shubham Mishra; Chandan Kumar; Ahmad Ali; Jeevan Bala

Year: 2021

Link: https://ieeexplore.ieee.org/document/9445304

Objective

"QR Code Based Attendance Management System" is a mix of two web applications created for taking and putting attendance of the students on the regular routine in the school.

Methodology

The framework eliminates the drawn-out assignment of physically keeping up the attendance records via automating it. The system contains two interfaces one for student and another for the teacher. The main and important interface is of teacher's interface. All the important and additional information about the attendance monitoring system will be available in this interface only. The QR codes will not be

static it will be dynamic, it will keep on changing in every 30 seconds, so that no one can click photo and send to his friends or colleague to get a proxy attendance. After scanning the QR codes successfully the attendance will get punched automatically, but it does not mean that this will be the final submission, The teacher still will have an option to mark someone present or absent according to his wish like, if someone's mobile or pc is not responding then teacher can give him attendance manually. Face recognition is a technique for distinguishing or confirming the identity of an individual using their face. Face recognition frameworks can be utilized to distinguish individuals in photographs, video, or progressively. For better accuracy of face-log generation, we employed face tracking technique like node face recognition api and libraries.

Limitation

If someone's mobile or pc is not responding then teacher can give him attendance manually. Chances of a proxy attendance is very less.

Conclusion

Taking a gander at the current circumstance, we have considered utilizing the versatile innovation to productively profit by the total allotted time appointed to a lecture. Time taken by educators to gauge attendance might be seen once in a while as a misuse of the lecture time, particularly when classes are huge. For that, we have proposed an approach to computerize this cycle utilizing the students' gadgets instead of the teacher's gadget.

3. Face Recognition Attendance System Based on Real-Time Video Processing

Author: Hao Yang; Xiaofeng Han

Year: 2020

Link: https://ieeexplore.ieee.org/document/9138372

Objective

This article aims to design a face recognition time and attendance system based on real-time video processing.

Methodology

Faces in surveillance videos often suffer from serious image blur, posture changes, and occlusion. In order to overcome the challenges of video-based face recognition (VFR), Ding C has proposed a comprehensive framework based on convolutional neural network (CNN). First, in order to learn a fuzzy and robust face representation, Ding C artificially blurs the training data composed of clear still images to make up for the lack of real video training data. Using training data composed of still images and artificial fuzzy data, CNN is encouraged to automatically learn fuzzy insensitive features. Second, in order to enhance the robustness of CNN features to pose changes and occlusion, CNN has proposed a trunk branch CNN model (TBE-CNN), which extracts complementarity from the overall face image and the patches around the face parts Information.

Limitation

The system fails to correctly judge that the two identifiers are very similar. Most students face information errors that will change, such as changes in facial features, accessories, cosmetics and lighting caused by medical plastics, making it impossible to extract the correct logo from the picture.

Conclusion

In this article, a face recognition attendance system based on real-time video processing is designed, and two colleges in a province are selected for real-time check-in and inspection of student attendance. This article mainly sets four directions to consider the problems: the accuracy rate of the face recognition system in the actual check-in, the stability of the face recognition attendance system with real-time video processing, and the truancy rate of the face recognition attendance system with real-time video processing It is difficult to analyze the interface settings

of the face recognition attendance system using real-time video processing. Research data shows that the accuracy of the video face recognition system is about 82%.

4. Design of an E-Attendance Checker through Facial Recognition using Histogram of Oriented Gradients with Support Vector Machine

Author: Allan Jason C. Arceo; Renee Ylka N. Borejon; Mia Chantal R. Hortinela; Alejandro H. Ballado; Arnold C. Paglinawan

Year: 2020

Link: https://ieeexplore.ieee.org/document/9346403

Objective

The main purpose of this paper is to design an electronic attendance (E-Attendance) checker through facial recognition system using Histogram of Oriented Gradients with Support Vector Machine by considering its (a) conceptual framework, (b) process flow, and (c) implementation while considering the camera and class size optimization.

Methodology

As for the facial recognition algorithms, three of the more common techniques are assessed in research done by Adouani et al. These three algorithms are namely Haar-like cascade, Histogram of Oriented Gradients (HOG) with Support Vector Machine and Liner Binary Pattern cascade (LBP). It was determined that the Histogram of Oriented Gradients (HOG) with Support Vector Machine algorithm outperforms the other two algorithms in terms of confidence factors. HOG with SVM is deemed to be the most accurate and efficient face recognition algorithm available in the OpenCV library.

Limitation

On the other hand, the accuracy will also decrease as students will now be wearing face masks and face shields that will affect the face detection and

recognition of the system. With this, it is best to add more data or training images to overcome the effect of the face masks and face shields.

Conclusion

A design of an e-attendance checker was established using HOG and SVM algorithms for face detection and face recognition, respectively. The process flows from taking an image and then implementing face detection via HOG which transpires and ends with the face recognition using the SVM algorithm. Its output was shown in an online database that includes the names of the students and the date and time the attendance was taken.

5. Deep Unified Model for Face Recognition Based on Convolution Neural Network and Edge Computing

Author: Muhammad Zeeshan Khan; Saad Harous; Saleet Ul Hassan; Muhammad Usman Ghani Khan; Razi Iqbal; Shahid Mumtaz

Year: 2019

Link: https://ieeexplore.ieee.org/document/8721062

Objective

To achieve better results, proposed algorithm utilizes the Convolution Neural Network, which is a deep learning approach and state-of the-art in computer vision.

Methodology

The proposed methodology is able to recognize the people even when frame has multiple faces. This system is capable of recognizing the people from different positions and under different lighting conditions, as light does not have much effect on the system. Moreover, to improve the data latency and response time, edge computing has been utilized for implementing the smart class rooms in real time. This paper proposes an algorithm for face detection and recognition based on convolution neural networks (CNN), which outperform the traditional techniques.

In order to validate the efficiency of the proposed algorithm, a smart classroom for the student's attendance using face recognition has been proposed.

Limitation

The system works well if pictures are taken from around 20–25 feet. The future of this work is to enhance the robustness of system by overcoming the following challenges: tilted face, moustache and growing beard. Furthermore, we are planning to work on observing introvert and extrovert behavior based on our proposed face recognition algorithm.

Conclusion

Automatic attendance system has been anticipated for the purpose of minimizing the human errors which take place in the conventional attendance taking system to validate the efficiency of the proposed algorithm. The basic aim is to automate the system and implement the smart class room which is useful for educational organizations. Faster Region Convolution Neural Network along with the Edge Computing techniques are utilized to achieve the state–of–the–art results. The system managed to recognize 30 faces out of 35 detected faces, the achieved accuracy can be more enhanced by taking clearer image of students. Although the system is achieving higher accuracy, but the main limitation of the system is distance, naturally as a distance increase, the picture becomes blurry, so the system produces false results on the blurry faces in some cases.

CHAPTER 3

SYSTEM ANALYSIS

3.1. Existing System

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 essentially based on face, fingerprint, and iris recognition technologies Facial recognition is a technology that is capable of recognizing a person based on their face. It employs machine learning algorithms which find, capture, store and analyses facial features in order to match them with images of individuals in a pre-existing database.

Early approaches mainly 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

- **Support Vector Machine (SVM)**

Support Vector Machines (SVM) are a popular training tool which can be used to generate a model based on several classes of data, and then distinguish between them. For the basic two-class classification problem, the goal of an SVM is to separate the two classes by a function induced from available examples. In the case

of facial recognition, a class represents a unique face, and the SVM attempts to find what best separates the multiple feature vectors of one unique face from those of another unique face.

- **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 the Eigen 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, Computer vision and Pattern recognition. The main principal of principal component analysis is reducing the dimensionality of a database. In the communication of large number of interrelated features and those retaining as much as possible of the variation in the database

- **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 pixels in 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.

- **Neural Network (NN)**

Neural Network has continued to use pattern recognition and classification. Kohonen was 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 make a 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.

- **K-Nearest Neighbors**

One of the basic classification algorithms in machine learning is known to be the k-NN algorithm. In machine learning, the k-NN algorithm is considered a well monitored type of learning. It is commonly used in the sorting of related elements in searching apps. By constructing a vector representation of objects and then measuring them using appropriate distance metrics, the similarities between the items are determined.

Other Application used FR

- Face Recognition Applications are Security System and Smart Home Automation System.
- Face recognition-based voting system are proposed

3.1.1 Disadvantages

- Calling students' names in virtual classrooms to take attendance is both trivial and time-consuming.
- Students may resort to unethical activities like not attending the class but still keeping their status as `online'.
- student can go offline at any time without letting the teacher know.
- it is not easy to find out whether the student is really attending the class.
- student might have turned off the video camera.

- All the existing process will consume valuable lecturing time and will affect the teaching efficiency.
- The accuracy of the system is not 100%.
- Face detection and loading training data processes just a little bit slow.
- It can only detect face from a limited distance.
- The instructor and training set manager still have to do some work manually.
- Handcrafted feature
- High Computational Complexity

3.2. Proposed System

Proposed System of the project introduces the novel feature of randomness in an AI-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.

Develops a user-friendly attendance recording system for teachers that can automatically record students' attendance and generate attendance reports for virtual classrooms. Deep learning in the form of Convolutional Neural Networks (CNNs) to perform the face recognition.

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 or 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.

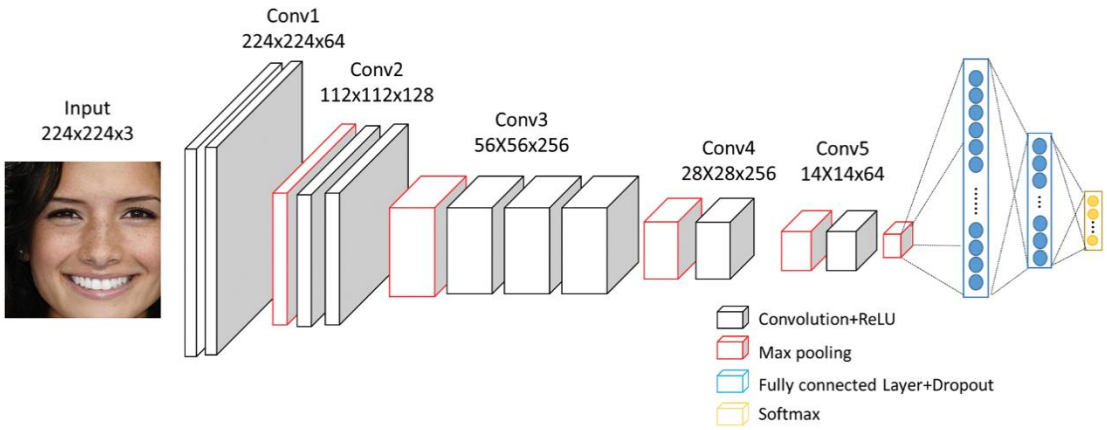


Figure 3.1 Deep Convolutional Neural Network

A. 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.

B. Pooling Layer: Pooling layer reduces the dimensionality of each activation map but continues to have the most important information. The input images are divided into a set of non-overlapping rectangles. Each region is down-sampled by a non-linear operation such as average or maximum. This layer achieves better generalization, faster convergence, robust to translation and distortion and is usually placed between convolutional layers.

C. ReLU Layer: ReLU is a non-linear operation and includes units employing the rectifier. It is an element wise operation that means it is applied per pixel and reconstitutes all negative values in the feature map by zero. In order to understand how the ReLU operates, we assume that there is a neuron input given as x and from that the rectifier is defined as f(x)= max (0, x) in the literature for neural networks.

D. Fully Connected Layer: Fully Connected Layer (FCL) term refers to that every filter in the previous layer is connected to every filter in the next layer. The output from the convolutional, pooling, and ReLU layers are embodiments of high-level features of the input image. The goal of employing the FCL is to employ these features for classifying the input image into various classes based on the training dataset. FCL is regarded as final pooling layer feeding the features to a classifier that uses SoftMax activation function. The sum of output probabilities from the Fully Connected Layer is 1. This is ensured by using the SoftMax as the activation function. The SoftMax function takes a vector of arbitrary real-valued scores and squashes it to a vector of values between zero and one.

3.2.1 Advantages

- Randomness ensures that students cannot predict at which instant of time the attendance is registered.
- highly efficient and robust attendance management system for virtual learning,
- Monitors students' attendance and engagement during virtual learning without affecting their focus on learning.
- students' attention and engagement in virtual learning are enhanced.
- Introduces the novel feature of randomness
- face-embedding learning approach that yielded a recognition accuracy of 98.95%

CHAPTER 4

SYSTEM SPECIFICATIONS

4.1 HARDWARE SPECIFICATION

- Processors: Intel® Core™ i5 processor 4300M at 2.60 GHz or 2.59 GHz (1 socket, 2 cores, 2 threads per core), 8 GB of DRAM
- Disk space: 320 GB
- Operating systems: Windows® 10, macOS*, and Linux*

4.2 SOFTWARE SPECIFICATION

- Server Side : Python 3.7.4(64-bit) or (32-bit)
- Client Side : HTML, CSS, Bootstrap
- IDE : Flask 1.1.1
- Back end : MySQL 5.
- Server : Wampserver 2i
- OS : Windows 10 64 –bit or Ubuntu 18.04 LTS "Bionic Beaver"

4.3 SOFTWARE DESCRIPTION

4.3.1 Python 3.7.4

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. It was created by Guido van Rossum during 1985-1990. Like Perl, Python source code is also available under the GNU General Public License (GPL). This tutorial gives enough understanding on Python programming language.

Tensor Flow

TensorFlow is an end-to-end open-source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries, and community resources that lets researchers push the state-of-the-art in ML, and gives developers the ability to easily build and deploy ML-powered applications.

Keras

Keras is a deep learning API written in Python, running on top of the machine learning platform TensorFlow. It was developed with a focus on enabling fast experimentation.

Pandas

Pandas is a fast, powerful, flexible and easy to use open source data analysis and manipulation tool, built on top of the Python programming language. pandas is a Python package that provides fast, flexible, and expressive data structures designed to make working with "relational" or "labeled" data both easy and intuitive. It aims to be the fundamental high-level building block for doing practical, real world data analysis in Python.

NumPy

NumPy, which stands for Numerical Python, is a library consisting of multidimensional array objects and a collection of routines for processing those arrays. Using NumPy, mathematical and logical operations on arrays can be performed.

NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays.

Matplotlib

Matplotlib is a comprehensive library for creating static, animated, and interactive visualizations in Python. Matplotlib makes easy things easy and hard things possible.

Matplotlib is a plotting library for the Python programming language and its numerical mathematics extension NumPy. It provides an object-oriented API for embedding plots into applications using general-purpose GUI toolkits like Tkinter, wxPython, Qt, or GTK.

Scikit Learn

Scikit-learn is a Python module for machine learning built on top of SciPy and is distributed under the 3-Clause BSD license.

Scikit-learn (formerly scikits.learn and also known as sklearn) is a free software machine learning library for the Python programming language.It features various classification, regression and clustering algorithms including support-vector machines, random forests, gradient boosting, k-means and DBSCAN, and is designed to interoperate with the Python numerical and scientific libraries NumPy and SciPy.

Pillow

Pillow is the friendly PIL fork by Alex Clark and Contributors. PIL is the Python Imaging Library by Fredrik Lundh and Contributors.

Python pillow library is used to image class within it to show the image. The image modules that belong to the pillow package have a few inbuilt functions such as load images or create new images, etc.

OpenCV

OpenCV is an open-source library for the computer vision. It provides the facility to the machine to recognize the faces or objects.

In OpenCV, the CV is an abbreviation form of a computer vision, which is defined as a field of study that helps computers to understand the content of the digital images such as photographs and videos.

4.3.2 MySQL

MySQL is a relational database management system based on the Structured Query Language, which is the popular language for accessing and managing the records in the database. MySQL is open-source and free software under the GNU license. It is supported by Oracle Company. MySQL database that provides for how to manage database and to manipulate data with the help of various SQL queries. These queries are: insert records, update records, delete records, select records, create tables, drop tables, etc. There are also given MySQL interview questions to help you better understand the MySQL database.

4.3.3 WampServer

WampServer is a Windows web development environment. It allows you to create web applications with Apache2, PHP and a MySQL database. Alongside, PhpMyAdmin allows you to manage easily your database.

WampServer is a reliable web development software program that lets you create web apps with MYSQL database and PHP Apache2. With an intuitive interface, the application features numerous functionalities and makes it the preferred choice of developers from around the world. The software is free to use and doesn’t require a payment or subscription.

4.3.4 Bootstrap 4

Bootstrap is a free and open-source tool collection for creating responsive websites and web applications. It is the most popular HTML, CSS, and JavaScript framework for developing responsive, mobile-first websites.

4.3.5 Flask

Flask is a web framework. This means flask provides you with tools, libraries and technologies that allow you to build a web application. This web application can be some web pages, a blog, a wiki or go as big as a web-based calendar application or a commercial website.

CHAPTER 5

SYSTEM DESIGN

5.1. AIPresent Architecture

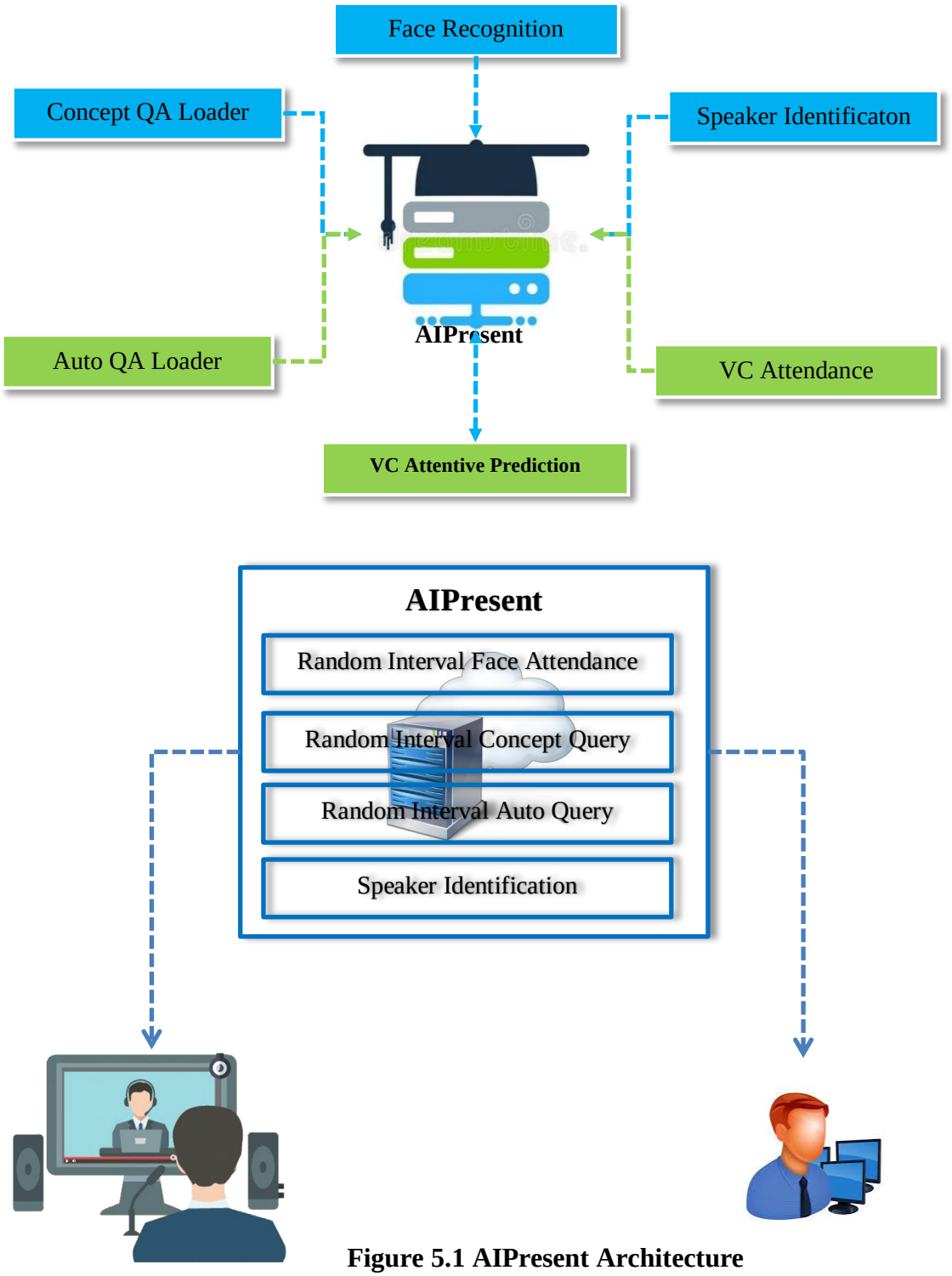


Figure 5.1 AIPresent Architecture

5.2. System Architecture

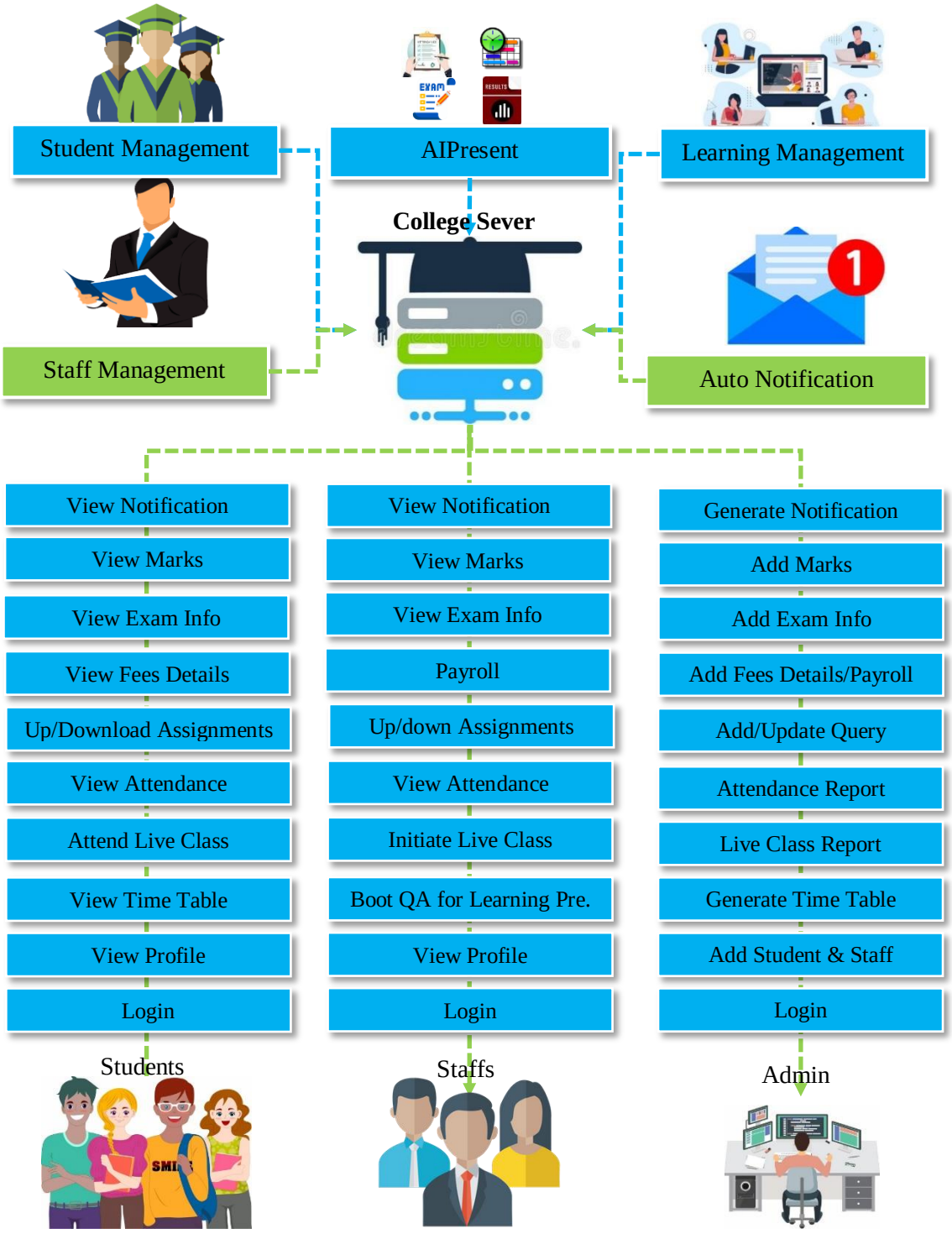


Figure 5.2 System Architecture

5.3. Architecture For Automatic Random Interval Face Recognition Attendance

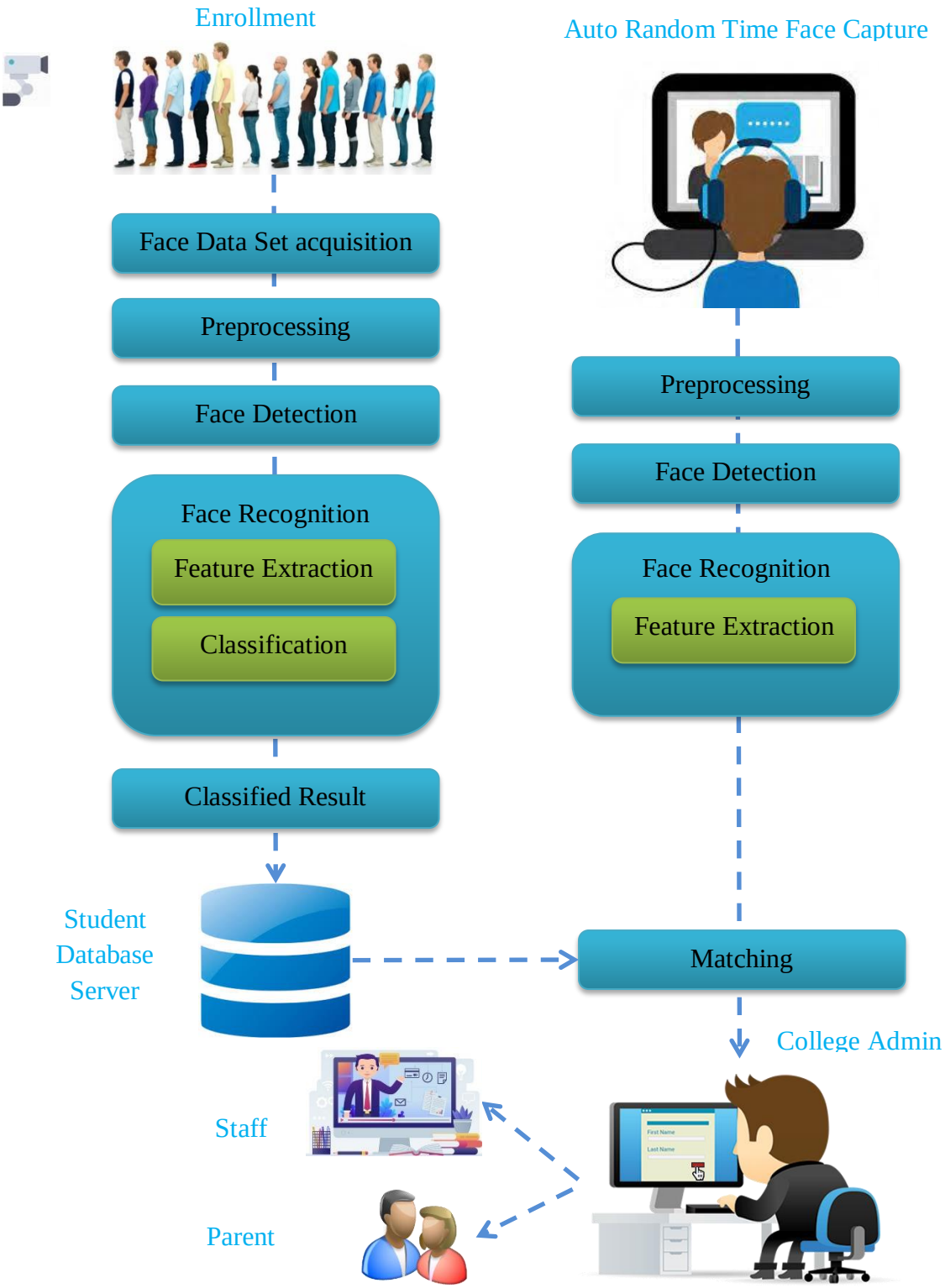


Figure 5.3 Architecture for automatic random interval face recognition attendance

5.4. Flowchart

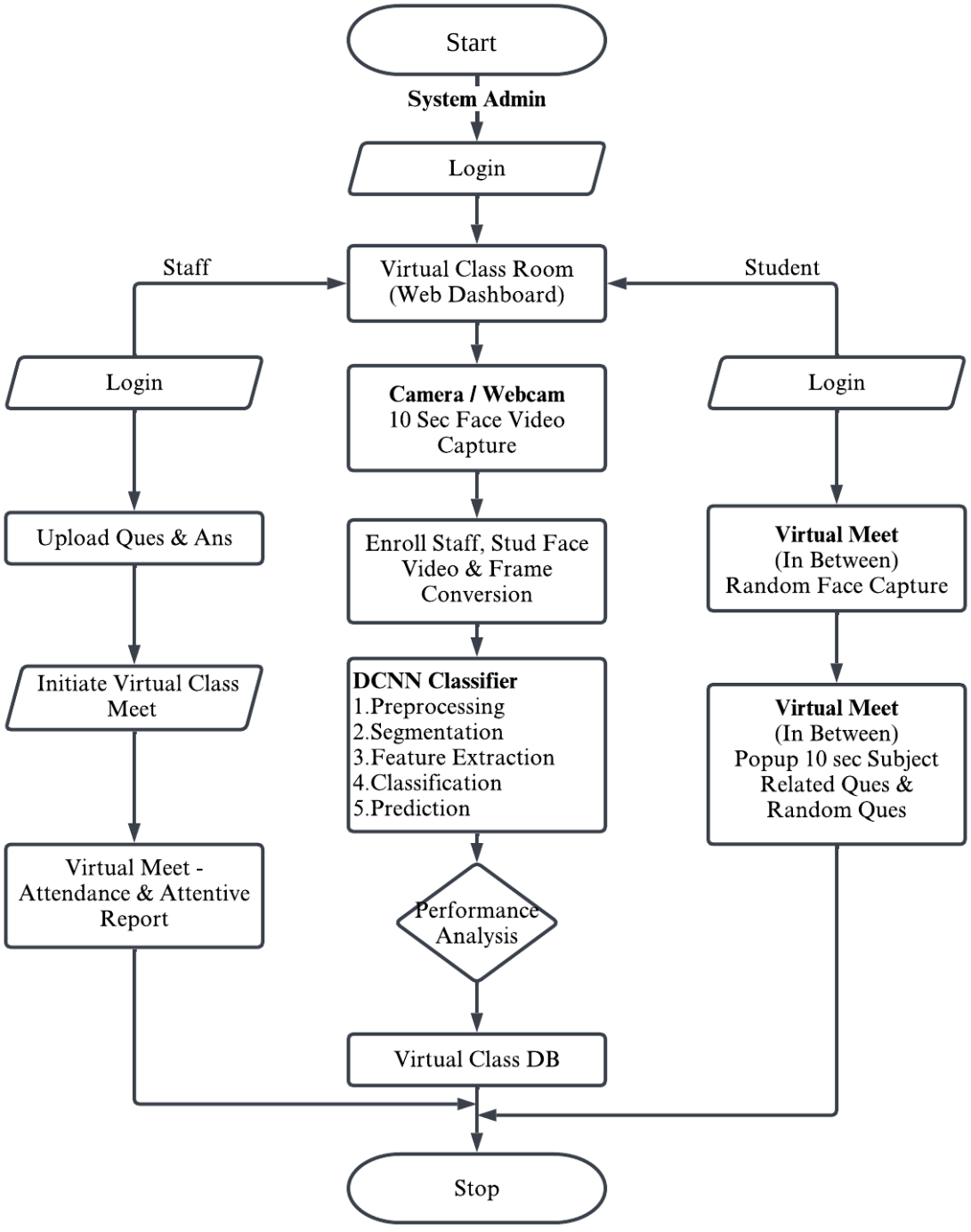


Figure 5.4. Flowchart for virtual meet

CHAPTER 6

MODULE DESCRIPTION

6.1. Problem Description

The teacher or lecturer has to enter the attendance of each student manually for each virtual class into their particular campus software. Creating many copies of the attendance record is also a difficult duty for additional academic purposes. In the virtual classrooms, a main issue with fingerprint and iris recognition is the unobtainable of fingerprint and iris scanners in students' devices. Not all smartphones are equipped with these scanners. In the existing online meeting applications, there are no interfaces to recognize the fingerprint and iris patterns of each students. The solution for this problem is face tracking method using machine learning.

The processes flow is first, the link is sent to both the teachers or lecturers and students on correct time. Teachers or lecturers and students should log in to the virtual classroom by using their smart devices. We simply considered `N' as the total number of students registered for the course.

In each session, students should turn ON the camera for the period of time compulsory**.** In the virtual class, all students' faces are extracted from the video frames at a random of intervals and store it in the host server. Mainly, students should respond to the CAPTCHAs, prompted by pop-ups at random intervals and also students should enter their UIN (Unique Identification Number) to confirm their presence or active in the virtual classroom for the attendance, the student should enter their CAPTCHAs and UIN within 30seconds. The CAPTCHAs and UIN is used to monitors students' attendance and engagement during the virtual learning. Attendance is registered automatically based on the weighted sum of the face matching, CAPTCHAs, and UIN responses only.

6.2. Modules Description

6.2.1 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 AIPresent 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.

1) It provides the teacher with a timely reminder to click the web-screen for capturing all students' faces of the virtual class for initiating the attendance entry.

2) It performs the extraction of face images from the web screen.

6.2.2 AIPresent Module

6.2.2.1 Enrollment Phase

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

6.2.2.2 Face Image Acquisition-

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

6.2.2.2.1 Frame Extraction

Frames are extracted from video input. The video must be divided into sequence of images which are further processed. The speed at which a video must be divided into

images depends on the implementation of individuals. From we can say that, mostly 20-30 frames are taken per second which are sent to the next phases.

6.2.2.3 . Pre-processing

Face Image pre-processing are the steps taken to format images before they are used by model training and inference. The steps to be taken are:

- Read image
- RGB to Grey Scale conversion
- Resize image

Original size (360, 480, 3) — (width, height, no. RGB channels)

Resized (220, 220, 3)

- Remove noise (Denoise)

smooth our image to remove unwanted noise. We do this using gaussian blur.

- Binarization

Image binarization is the process of taking a grayscale image and converting it to black-and-white, essentially reducing the information contained within the image from 256 shades of grey to 2: black and white, a binary image. The below figure 6.1 shows pre-processing.

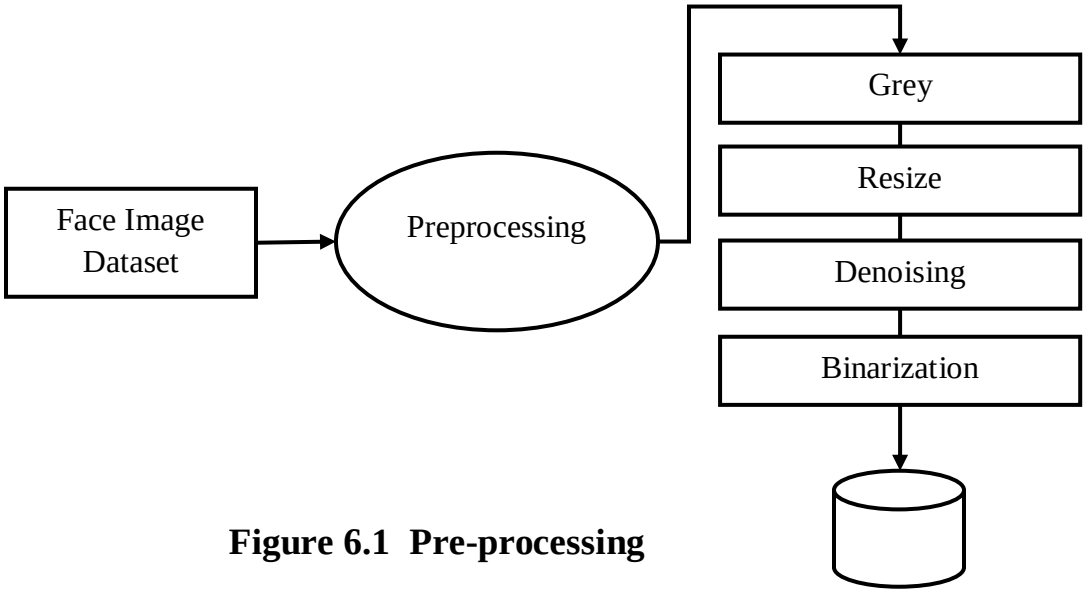


Figure 6.1 Pre-processing

6.2.2.4 Face Detection

Therefore, in this module, Region Proposal Network (RPN) generates RoIs by sliding windows on the feature map through anchors with different scales and different aspect ratios. Face detection and segmentation method based on improved RPN. RPN is used to generate RoIs, and RoI Align faithfully preserves the exact spatial locations. These are responsible for providing a predefined set of bounding boxes of different sizes and ratios that are going to be used for reference when first predicting object locations for the RPN. The below figure 6.2 shows segmentation.

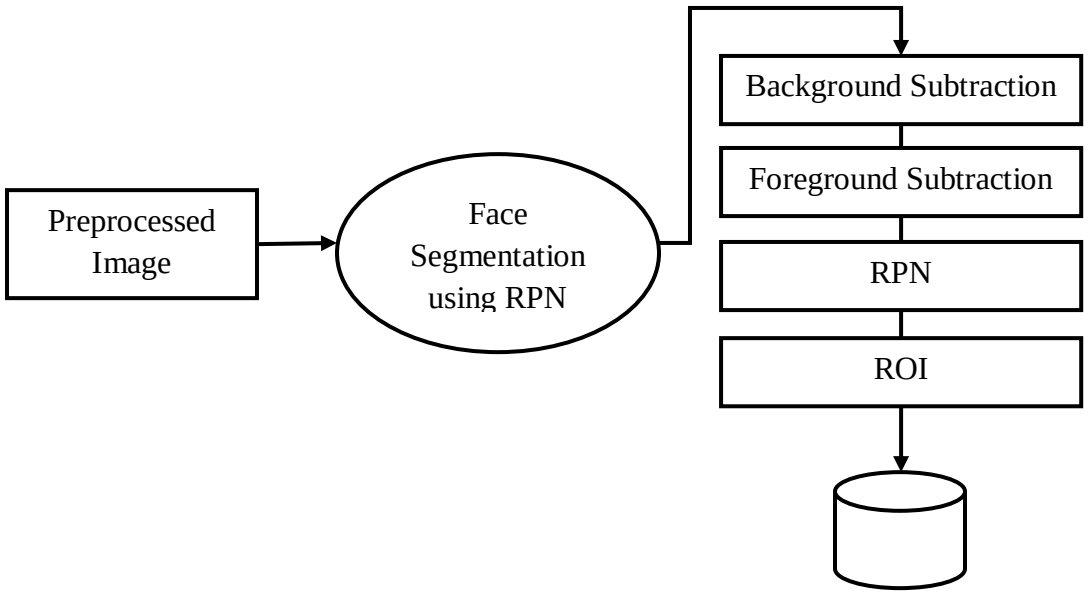


Figure 6.2 Segmentation

- **Face Image segmentation using region growing (RG) method**

The region growing methodology and recent related work of region growing are described here.

RG is a simple image segmentation method based on the seeds of region. It is also classified as a pixel-based image segmentation method since it involves the selection of initial seed points. This approach to segmentation examines the neighbouring pixels of initial “seed points” and determines whether the pixel neighbours should be added to the region or not based on certain conditions. In a normal region growing

technique, the neighbour pixels are examined by using only the "intensity" constraint. A threshold level for intensity value is set and those neighbour pixels that satisfy this threshold is selected for the region growing.

- **RPN**

A **Region Proposal Network**, or **RPN**, is a fully convolutional network that simultaneously predicts object bounds and objectless scores at each position. The RPN is trained end-to-end to generate high-quality region proposals. It works on the feature map (output of CNN), and each feature (point) of this map is called Anchor Point. For each anchor point, we place 9 anchor boxes (the combinations of different sizes and ratios) over the image. These anchor boxes are cantered at the point in the image which is corresponding to the anchor point of the feature map. The below figure 6.2.1 shows RPN.

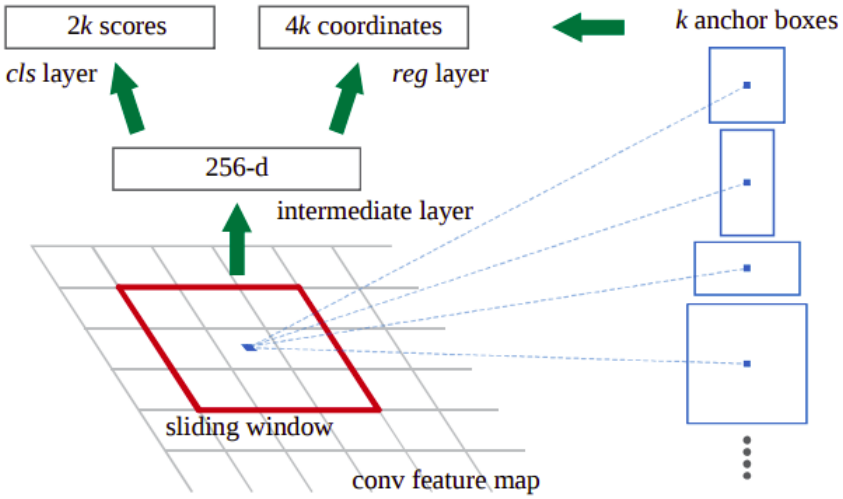


Figure 6.2.1 RPN

- **Training of RPN.**

To know that for each location of the feature map we have 9 anchor boxes, so the total number is very big, but not all of them are relevant. If an anchor box having an object or part of the object within it then can refer it as a **foreground**, and if the anchor box doesn't have an object within it then we can refer it as **background**.

So, for training, assign a label to each anchor box, based on its Intersection over Union (IoU) with given ground truth. We basically assign either of the three (1, -1, 0) labels to each anchor box.

Label = 1 (Foreground): An anchor can have label 1 in following conditions,

If the anchor has the highest IoU with ground truth.

If the IoU with ground truth is greater than 0.7. (IoU >0.7).

Label = -1 (Background): An anchor is assigned with -1 if IoU < 0.3.

Label = 0: If it doesn't fall under either of the above conditions, these types of anchors don't contribute to the training, they are ignored.

After assigning the labels, it creates the mini-batch of 256 randomly picked anchor boxes, all of these anchor boxes are picked from the same image.

The ratio of the number of positive and negative anchor boxes should be 1:1 in the mini-batch, but if there are less than 128 positive anchor boxes then we pad the mini-batch with negative anchor boxes.

Now the RPN can be trained end-to-end by backpropagation and stochastic gradient descent (SGD).

The processing steps are

- Select the initial seed point
- Append the neighbouring pixels—intensity threshold
- Check threshold of the neighbouring pixel
- Thresholds satisfy-selected for growing the region.
- Process is iterated to end of all regions.

6.2.2.5 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. With each pose, the facial information including eyes, nose and mouth is automatically extracted and is then

used to calculate the effects of the variation using its relation to the frontal face templates. The below figure 6.3 shows Feature Extraction.

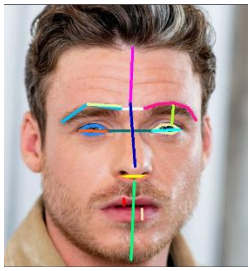


Figure 6.3 Feature Extraction

6.2.2.6. GLCM (Gray Level Co-occurrence Matrix)

GLCM is a second-order statistical texture analysis method. It examines the spatial relationship among pixels and defines how frequently a combination of pixels are present in an image in a given direction Θ and distance d. Each image is quantized into 16 gray levels (0–15) and 4 GLCMs (M) each for Θ = 0, 45, 90, and 135 degrees with d = 1 are obtained. From each GLCM, five features (Eq. 13.30–13.34) are extracted. Thus, there are 20 features for each image. Each feature is normalized to range between 0 to 1 before passing to the classifiers, and each classifier receives the same set of features.

The features we extracted can be grouped into three categories. The first category is the first order statistics, which includes maximum intensity, minimum intensity, mean, median, 10th percentile, 90th percentile, standard deviation, variance of intensity value, energy, entropy, and others. These features characterize the Gray level intensity of the tumour region. The below figure 6.3.1 shows Gray Level Co-occurrence Matrix.

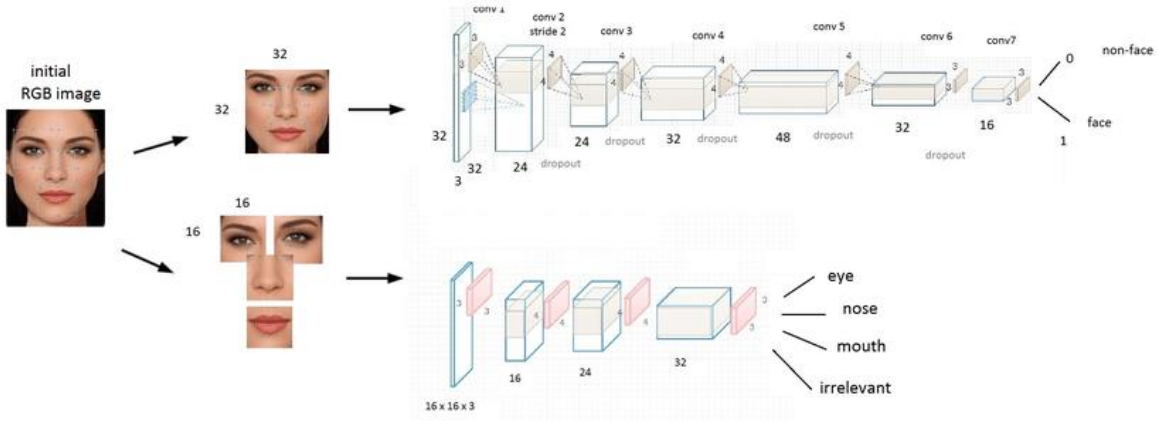


Figure 6.3.1 Gray Level Co-occurrence Matrix

The second category is shape features, which include volume, surface area, surface area to volume ratio, maximum 3D diameter, maximum 2D diameter for axial, coronal and sagittal plane respectively, major axis length, minor axis length and least axis length, sphericity, elongation, and other features. These features characterize the shape of the tumour region.

The third category is texture features, which include 22 Gray level co-occurrence matrix (GLCM) features, 16 Gray level run length matrix (GLRLM) features, 16 Gray level size zone matrix (GLSZM) features, five neighbouring Gray tone difference matrix (NGTDM) features and 14 Gray level dependence matrix (GLDM) Features. These features characterize the texture of the tumour region. The below Table 6.2, 6.3, 6.4 Shows Facial Attribute, Facial Feature Measurement, GLCM.

	image_id	lefteye_x	lefteye_y	righteye_x	righteye_y	nose_x	nose_y	leftmouth_x	leftmouth_y	rightmouth_x	rightmouth_y
0	000001.jpg	69	109	106	113	77	142	73	152	108	154
1	000002.jpg	69	110	107	112	81	135	70	151	108	153
2	000003.jpg	76	112	104	106	108	128	74	156	98	158
3	000004.jpg	72	113	108	108	101	138	71	155	101	151
4	000005.jpg	66	114	112	112	86	119	71	147	104	150

TABLE 6.1 Facial Attribute

Feature	Measure
forehead height	82.0
middle face height	68.0
lower face height	86.0
left eye area	216.0
right eye area	194.0
eye to eye dist	47.0
eye to eyebrow dist	17.5
upper lip height	6.0
lower lip height	11.0
eyebrows distance	29.0
nose length	46.0
nose width	41.0
nose arc	147.0
eyebrow shape detector 1	141.0
eyebrow shape detector 2	1.0
eye slope detector1	-0.265
eye slope detector2	1.847
eyebrow slope	-0.145

TABLE 6.2 Facial Feature Measurement

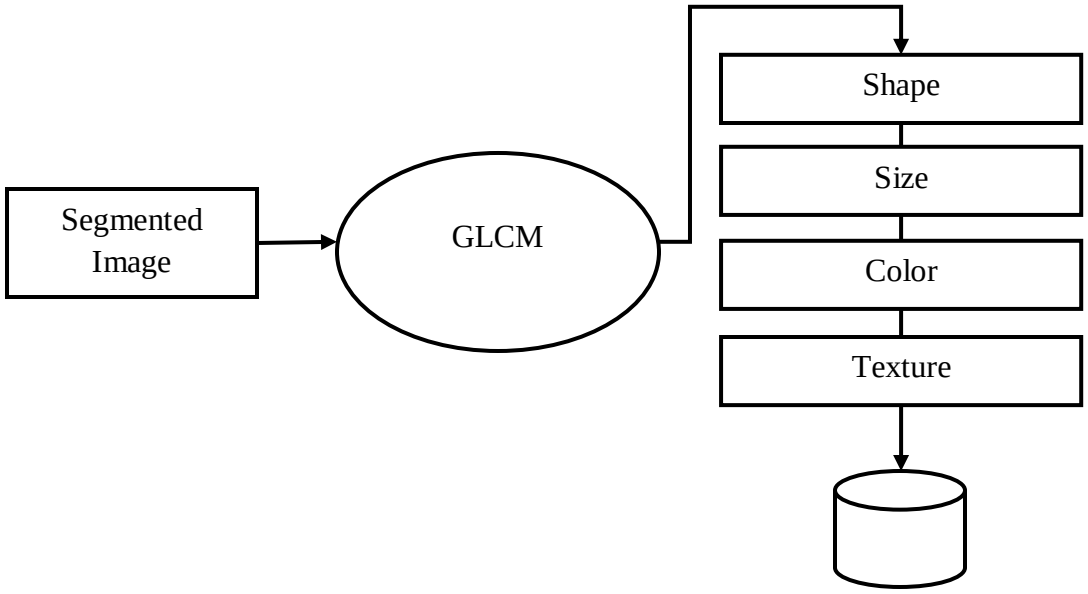


Figure 6.4 GLCM

5.2.2.6 Face ClassificatDCNN algorithms were created to automatically detect and reject improper face images during the enrolment process. This will ensure proper enrolment and therefore the best possible performance

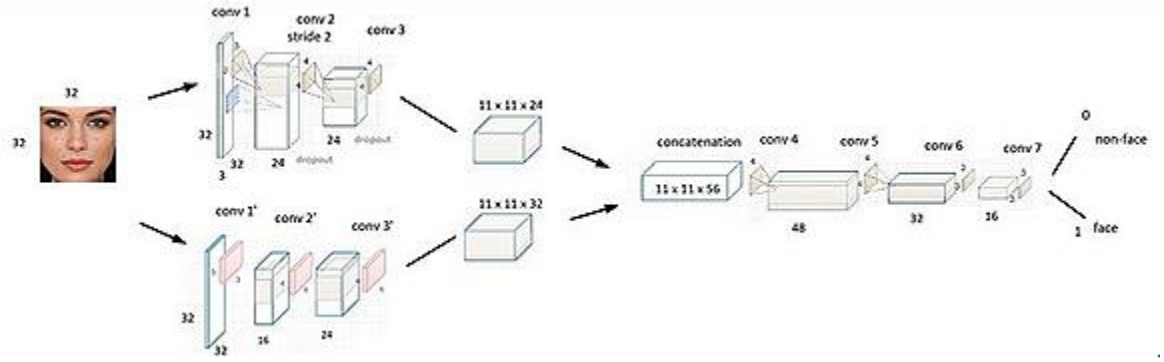


Figure 6.5 Face Classification

The CNN creates feature maps by summing up the convolved grid of a vector-valued input to the kernel with a bank of filters to a given layer. Then a non-linear rectified linear unit (ReLU) is used for computing the activations of the convolved feature maps. The new feature map obtained from the ReLU is normalized using local response normalization (LRN). The output from the normalization is further computed with the use of a spatial pooling strategy (maximum or average pooling).

Then, the use of dropout regularization scheme is used to initialize some unused weights to zero and this activity most often takes place within the fully connected layers before the classification layer. Finally, the use of softmax activation function is used for classifying image labels within the fully connected . The above figure 6.5 Shows Face Classification.The below figure6.5.1 Shows classifier.

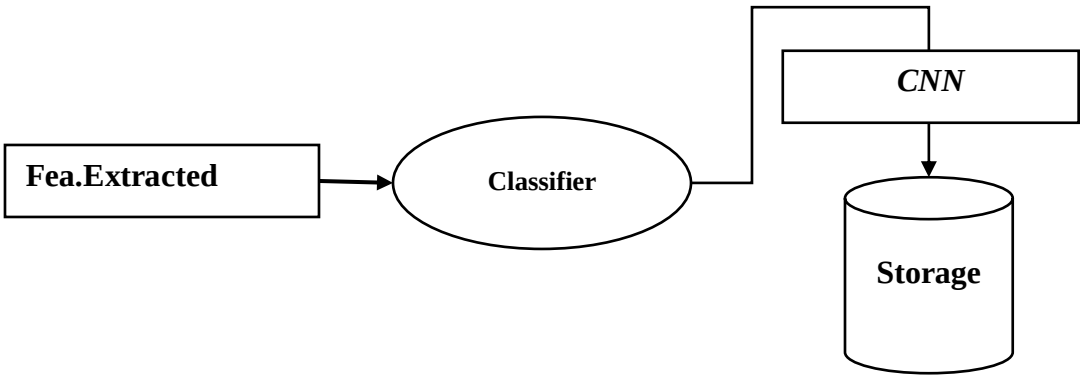


Figure 6.5.1 Classifier

6.2.3 Attendance System

After the verification of faces and successful recognition is done, the attendance of 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.

6.2.4 . Learning Attentive Prediction

In order 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 ConceptQA (P2) that pop-up k2-times in the students' device at random intervals. Also, the students have to enter their UIN k3-times (P3), when they are directed to do it randomly. The random intervals of time are designed in such a way that it follows the attention span distribution of the students.

6.2.5 Student Management

In this module, institute can enrol students to the college after counselling. 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 certificates
- Detailed profile & progress tracking
- Progress report

6.2.6 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

6.2.7 Academic Management

- Time-table
- Lesson Planning

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

6.2.8 Learning Management

- Organised 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 in different 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.
- Faculty/AP/HOD can Evaluate homework of each Student and Updating of Homework Status in Student, Faculty/AP/HOD & Parent Portal.

6.2.9 Communication

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

- Holiday updates

6.2.10 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 with an 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 types of leaves/absences/late comings can be marked for employees. By using this module, school management can easily record the regularity and punctuality of each employee including late coming, early going and can determine salary payable efficiently.

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

6.2.11 Reports & Analysis

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

6.2.12 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 notifications for 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, attend Live 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 Fees account, 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

6.2.13 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.

6.2.14 Performance Analysis

The below figure 5.6 Shows Parameter Definition. The important points involved with the performance metrics are discussed based on the context of this project:

True Positive (TP): There is a Face, and the algorithms detect Card Holder.

False Negative (FN): There is a Face, but the algorithms do not detect Card Holder and name.

True Negative (TN): There is no Face, and nothing is being detected.

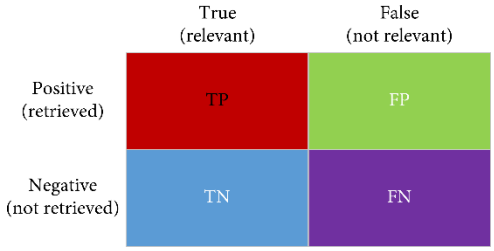


Figure 6.6 Parameter Definition

- **Accuracy**

The below figure 6.6.1 Shows Accuracy. Accuracy is a measure that tells whether a model/algorithm is being trained correctly and how it performs. In the context of this thesis, accuracy tells how well it is performing in detecting Face in ATM Machine. Accuracy is calculated using the following formula.

Accuracy = (T P + T N)/ (T P + T N + F P + F N)

Accuracy: 0.9984025559105432

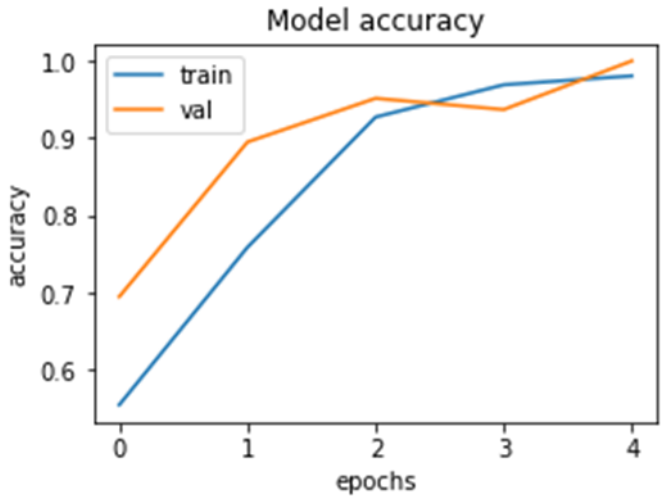


Figure 6.6.1 Accuracy

- **Precision**

The below figure 6.6.2 Shows Precision.It denotes the ratio of positively predicted cases that are actually positive. In the context of this thesis, precision measures the fraction of objects that are predicted to be Card Holder and are actually Card Holder Face present in ATM environment. Precision is calculated using the following formula.

Precision = T P/ (T P + F P)

Precision: 0.9990234375

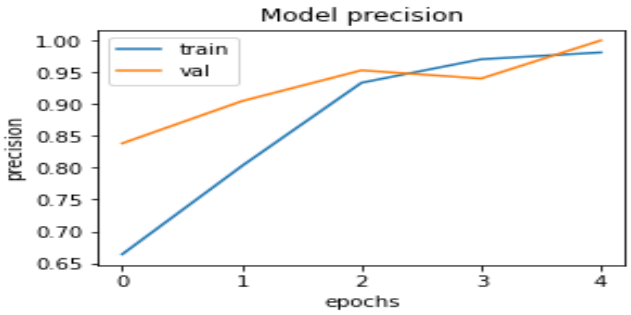


Figure 6.6.2 Precision

- **Recall**

The below figure 6.6.3 Shows Recall. It is the ratio between actual positive cases that are predicted to be positive. In the context of this thesis, recall measures the fraction of Face that are predicted as Face and identify the card Holder. Recall is calculated using the following formula.

Recall =T P/ (T P + F N)

Recall: 0.9964285714285714

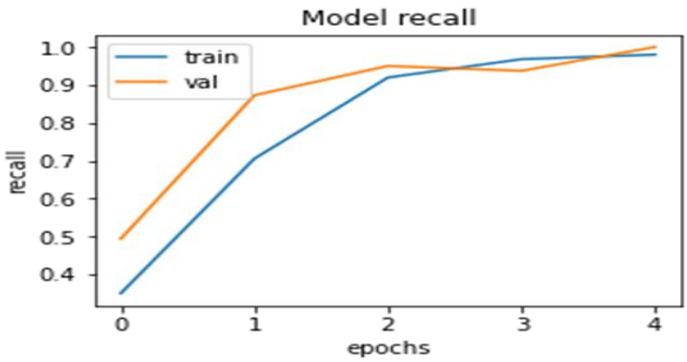


Figure 6.6.3 Recall

- **F1 Score**

It is also known as balanced F-score or F-measure. F1 score is a measure of accuracy of a model combining precision and recall. In the context of this thesis, a good F1 score shows that there are less false positives and false negatives. This shows that the model is correctly identifying Face in ATM environment.

A model/algorithm is considered perfect if F1 score is 1. It is calculated using the following formula.

F1 = 2 × (Precision × Recall /Precision + Recall)

F1_score: 0.9977122020583142

Training time

Training time is metric used in this thesis to measure the time taken to train the selected machine learning algorithms on the dataset.

Prediction Speed

Speed is a metric used in this thesis to measure the time taken for the algorithms to process and detect obstacle.

Loss Function

Loss function, to perform feature matching between the ground truth and the output of segmentation network, optimizing also the network weights on features

extracted at multiple resolutions rather than focusing just on the pixel level. The below figure 5.6.4 Shows Function Loss.

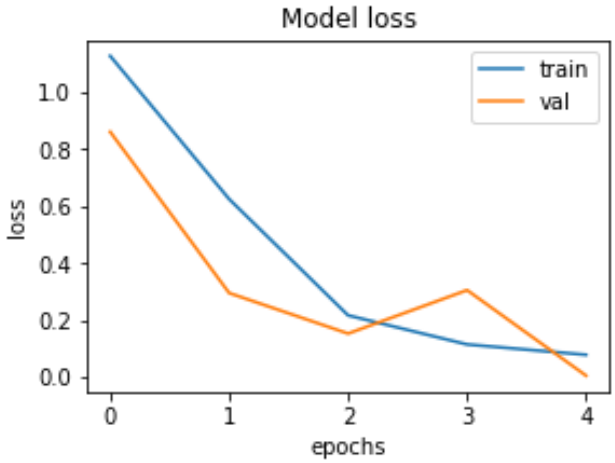


Figure 6.6.4 Function Loss

6.3. DCNN Overview

Deep learning is a machine learning technique used to build artificial intelligence (AI) systems. It is based on the idea of artificial neural networks (ANN), designed to perform complex analysis of large amounts of data by passing it through multiple layers of neurons. There is a wide variety of deep neural networks (DNN). Deep convolutional neural networks (CNN or DCNN) are the type most commonly used to identify patterns in images and video. DCNNs have evolved from traditional artificial neural networks, using a three-dimensional neural pattern inspired by the visual cortex of animals.

Deep convolutional neural networks are mainly focused on applications like object detection, image classification, recommendation systems, and are also sometimes used for natural language processing. Deep Convolutional Neural Networks (DCNN) is a Deep Learning (DL) Method which is different from normal Convolutional Neural Network (CNN) in terms of number of hidden layers usually more than 5 which are used to extract more features and increase the accuracy of the prediction. There are two kinds of DCNN, one is increasing the number of hidden

layers or by increasing the number of nodes in the hidden layer. The DCNN method that has been widely and successfully applied to computer vision tasks including object localization, detection, and image classification is a supervised learning task that uses the raw data to determine the classification features, in contrast to other machine learning (ML) techniques that require pre-selection of the input features (or attributes). The strength of DCNNs is in their layering. A DCNN uses a three-dimensional neural network to process the red, green, and blue elements of the image at the same time. This considerably reduces the number of artificial neurons required to process an image, compared to traditional feed forward neural networks. Deep convolutional neural networks receive images as an input and use them to train a classifier. The network employs a special mathematical operation called a "convolution" instead of matrix multiplication.

6.4. ALGORITHM DESCRIPTION

6.4.1 Working of Facial Recognition

The below Figure 6.7 Shows Working of Facial Recognition.

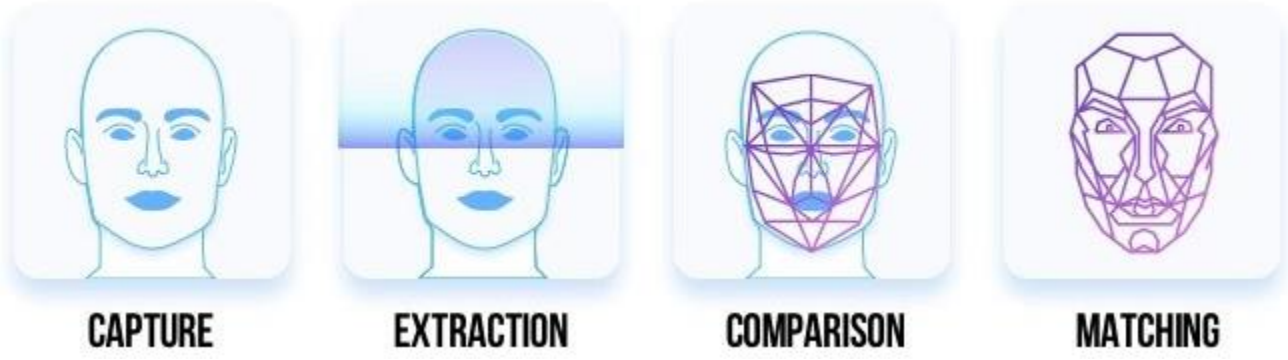


Figure 6.7 Working of Facial Recognition

1. **Concept of feature vector**: Every Machine Learning algorithm takes a dataset as input and learns from this data. The algorithm goes through the data and identifies patterns in the data. The challenging part is to convert a

particular face into numbers – Machine Learning algorithms only understand numbers.

2. This numerical representation of a "face" (or an element in the training set) is termed as a feature vector. A feature vector comprises of various numbers in a specific order.
3. You can take various attributes to define a face like:
    - Height/width of face (cm)
    - Color of face (R,G,B)
    - Height/width of parts of face like nose & lips (cm)
    - We can consider the ratios as feature vector after rescaling
4. A feature vector can be created by organising these attributes to into a table, say, for a certain set of values of attributes your table may look like this:

Height of face (cm)	**Width of face (cm)**	**Average color of face(R,G,B)**	**Width of lips (cm)**	**Height of nose(cm)**
23.1	15.8	(255, 224, 189)	5.2	4.4

Table 6.3 Feature Vector

image now becomes a vector that could be represented as [23.1, 15.8, 255, 224, 189, 5.2, 4.4]. Now can add a number of other features like hair color & spectacles. Keep in mind that a simple model gives the best result. Adding a greater number of features may not give accurate results (See overfitting and underfitting). The below figure5.7.1 shows Feature Vector.

[-0.23, -0.54, ..., 0.27]

Figure 6.7.1 Feature vector

6.5. DCNN Basic Architecture

There are two main parts to a CNN architecture

A **convolution tool** that separates and identifies the various features of the image for analysis in a process called as Feature Extraction

A **fully connected layer** that utilizes the output from the convolution process and predicts the class of the image based on the features extracted in previous stages.The below Figure 6.7.2 shows Face Landmark Points.

Figure 6.7.2 Face Landmark Points

There are mostly two steps to detect face landmarks in an image which are given below:

- **Face detection:** Face detection is the first methods which locate a human face and return a value in x,y,w,h which is a rectangle.
- **Face landmark:** After getting the location of a face in an image, then we have to through points inside of that rectangle. The below figure 6.8 shows CNN.

6.5.1 Convolution Layers

There are three types of layers that make up the CNN which are the convolutional layers, pooling layers, and fully-connected (FC) layers. When these layers are stacked, a CNN architecture will be formed. In addition to these three layers, there are two more important parameters which are the dropout layer and the activation function which are defined below.

1. Convolutional Layer

This layer is the first layer that is used to extract the various features from the input images. In this layer, the mathematical operation of convolution is performed between the input image and a filter of a particular size MxM. By sliding the filter over the input image, the dot product is taken between the filter and the parts of the input image with respect to the size of the filter (MxM).

The output is termed as the Feature map which gives us information about the image such as the corners and edges. Later, this feature map is fed to other layers to learn several other features of the input image.

2. Pooling Layer

In most cases, a Convolutional Layer is followed by a Pooling Layer. The primary aim of this layer is to decrease the size of the convolved feature map to reduce the computational costs. This is performed by decreasing the connections

between layers and independently operates on each feature map. Depending upon method used, there are several types of Pooling operations.

In Max Pooling, the largest element is taken from feature map. Average Pooling calculates the average of the elements in a predefined sized Image section. The total sum of the elements in the predefined section is computed in Sum Pooling. The Pooling Layer usually serves as a bridge between the Convolutional Layer and the FC Layer

3. Fully Connected Layer

The Fully Connected (FC) layer consists of the weights and biases along with the neurons and is used to connect the neurons between two different layers. These layers are usually placed before the output layer and form the last few layers of a CNN Architecture. In this, the input image from the previous layers is flattened and fed to the FC layer. The flattened vector then undergoes few more FC layers where the mathematical functions operations usually take place. In this stage, the classification process begins to take place.

4. Dropout

Usually, when all the features are connected to the FC layer, it can cause overfitting in the training dataset. Overfitting occurs when a particular model works so well on the training data causing a negative impact in the model's performance when used on a new data. To overcome this problem, a dropout layer is utilized wherein a few neurons are dropped from the neural network during training process resulting in reduced size of the model. On passing a dropout of 0.3, 30% of the nodes are dropped out randomly from the neural network.

CHAPTER 7

CONCLUSION AND FUTURE ENHENCEMENT

7.1. Conclusion

Random Interval Attendance Management System (AIPresent) 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. AIPresent 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, ConceptQA and UIN queries. The system captures face biometric from the video stream of participants and gathers the timely responses of students to ConceptQA and UIN queries, at random intervals of time. An intelligible and adaptive weighting strategy is employed for finalizing the decisions from the three modalities. AIPresent could be integrated with any existing virtual meeting platform through an application interface like a web page or a specific App.

7.2 Future Enhancement

By incorporating other ancillary modalities like speech recognition and adding suitable adaptive weights for each modality, the efficiency and reliability of the system can be further enhanced. Further implement this system to online examination.

APPENDIX A (SAMPLE CODING)

Add Student Information

```
from flask import Flask

from flask import Flask, render_template, Response, redirect, request, session, abort, url_for

from camera import VideoCamera

import cv2

import PIL.Image

from PIL import Image


@app.route('/register',methods=['POST','GET'])

def register():

    result=""

    act=""

    mycursor = mydb.cursor()

    mycursor.execute("SELECT distinct(category) FROM ci_category")

    value1 = mycursor.fetchall()


    if request.method=='POST':

        name=request.form['name']

        regno=request.form['regno']

        gender=request.form['gender']

        dob=request.form['dob']
```

```
        mobile=request.form['mobile']
        email=request.form['email']
        address=request.form['address']
        dept=request.form['dept']
        year=request.form['year']
        pass1=request.form['pass']



        now = datetime.datetime.now()
        rdate=now.strftime("%d-%m-%Y")



        mycursor.execute("SELECT count(*) FROM ci_student where
regno=%s",(regno, ))
        cnt = mycursor.fetchone()[0]
        if cnt==0:
            mycursor.execute("SELECT max(id)+1 FROM ci_student")
            maxid = mycursor.fetchone()[0]
            if maxid is None:
                maxid=1


            sql = "INSERT INTO
ci_student(id,name,regno,gender,dob,mobile,email,address,dept,year,pass)
VALUES (%s, %s, %s, %s, %s, %s, %s, %s, %s, %s, %s)"
```

```
            val = (maxid, name, regno, gender, dob, mobile, email, address, dept, year,
pass1)
            print(sql)
            mycursor.execute(sql, val)
            mydb.commit()
            print(mycursor.rowcount, "record inserted.")
            return redirect(url_for('add_photo',vid=maxid))
        else:
            result="Register No. already Exist!"
```

Face Detection and Compare

```
class VideoCamera(object):
    def __init__(self):
        self.video = cv2.VideoCapture(0)
        self.k=1

    def __del__(self):
        self.video.release()

    def get_frame(self):
        success, image = self.video.read()
        #self.out.write(image)
        face_cascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')
```

```
# Read the frame
#_, img = cap.read()
# Convert to grayscale
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)

# Detect the faces
faces = face_cascade.detectMultiScale(gray, 1.1, 4)
# Draw the rectangle around each face
j = 1

ff=open("user.txt","r")
uu=ff.read()
ff.close()

ff1=open("photo.txt","r")
uu1=ff1.read()
ff1.close()

for (x, y, w, h) in faces:
    mm=cv2.rectangle(image, (x, y), (x+w, y+h), (255, 0, 0), 2)
    cv2.imwrite("myface.jpg", mm)
    image = cv2.imread("myface.jpg")
    cropped = image[y:y+h, x:x+w]
```

```
            gg="f"+str(j)+".jpg"
            cv2.imwrite("faces/"+gg, cropped)


            ###
            self.k+=1
            fnn=uu+"_"+str(self.k)+".jpg"
            ff2=open("det.txt","w")
            ff2.write(str(self.k))
            ff2.close()
            if uu1=="2":
                cv2.imwrite("static/frame/"+fnn, cropped)
            #cv2.imwrite("https://iotcloud.co.in/testsms/upload/"+fnn, cropped)
            ###
            mm2 = PIL.Image.open('faces/'+gg)
            rz = mm2.resize((100,100), PIL.Image.ANTIALIAS)
            rz.save('faces/'+gg)
cutoff=10
    img="v"+str(vid)+".jpg"
    mycursor.execute('SELECT * FROM ci_face WHERE vid = %s', (vid, ))
    dt = mycursor.fetchall()
    ff="d_"+uname+".jpg"
    for rr in dt:
        hash0 = imagehash.average_hash(Image.open("static/frame/"+rr[2]))
```

```
    hash1 = imagehash.average_hash(Image.open("static/upload/"+ff))
    cc1=hash0 - hash1
    if cc1<=10:
        ss="ok"
        break
    else:
        ss="no"
```

Attendance

```
@app.route('/meet',methods=['POST','GET'])
def meet():
    msg=""
    uname=""
    act=""
    if 'username' in session:
        uname = session['username']


    print(uname)


    pid=request.args.get('pid')
    tid=request.args.get('tid')
    per=request.args.get('per')
```

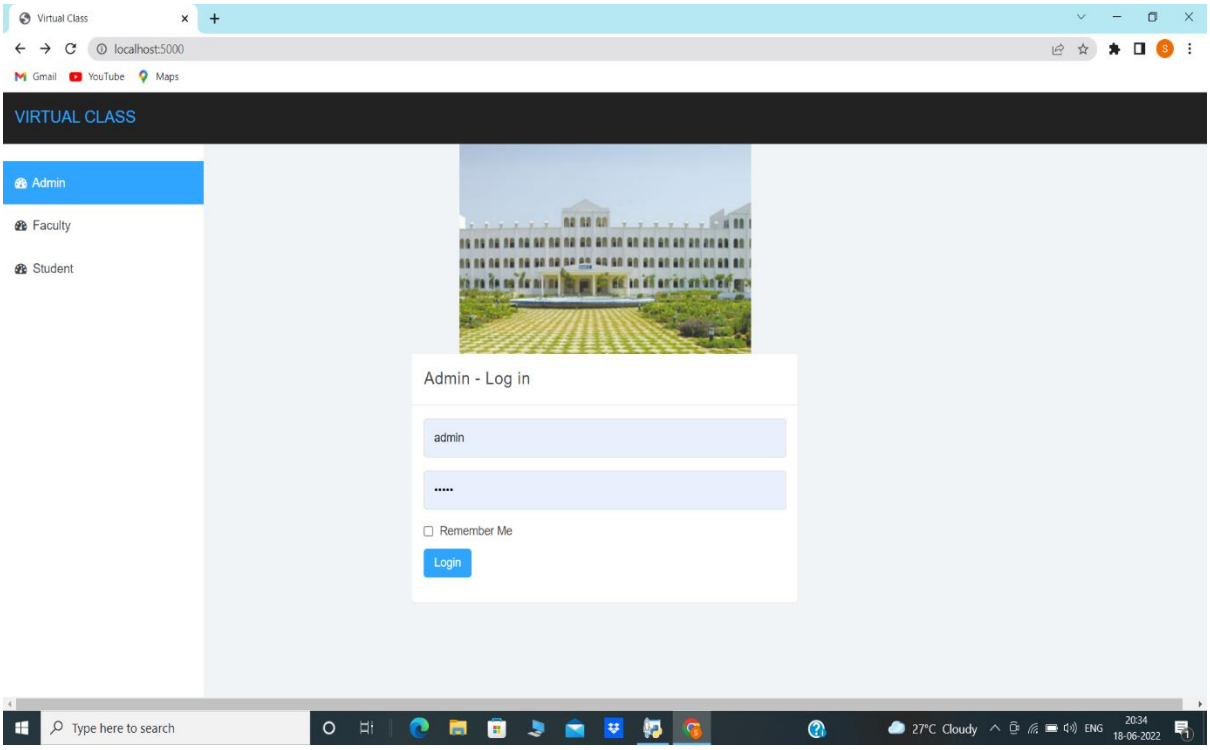
```
    ss=per.split('-')


    mycursor = mydb.cursor()
    mycursor.execute("SELECT * FROM ci_student where regno=%s",(uname, ))
    value3 = mycursor.fetchone()
    name=value3[1]
    dept=value3[8]
    sem=value3[9]
    capst=value3[16]
    staff=value3[17]
    value=[]
    data=[]
    if capst==1:
        act="1"
    else:
        act=""


    ff11=open("start.txt","r")
    start=ff11.read()
    ff11.close()


if start=="2":
        now = datetime.datetime.now()
```

```
        rdate=now.strftime("%d-%m-%Y")
        stime=now.strftime("%H:%M")
        print("start")

        mycursor.execute("SELECT count(*) FROM ci_time where regno=%s && rdate=%s",(uname, rdate))
        cnt = mycursor.fetchone()[0]
        if cnt==0:
            #########Time########
            mycursor.execute("SELECT max(id)+1 FROM ci_time")
            maxid = mycursor.fetchone()[0]
            if maxid is None:
                maxid=1

            sql = "INSERT INTO ci_time(id,regno,rdate,stime,num_mins,etime,staff) VALUES (%s, %s, %s, %s, %s,%s,%s)"
            val = (maxid, uname, rdate, stime, '0','0',staff)
            print(val)
            mycursor.execute(sql,val)
            mydb.commit()
            #############
        else:
            mycursor.execute("SELECT * FROM ci_time where regno=%s && rdate=%s order by id desc limit 0,1",(uname, rdate))
```

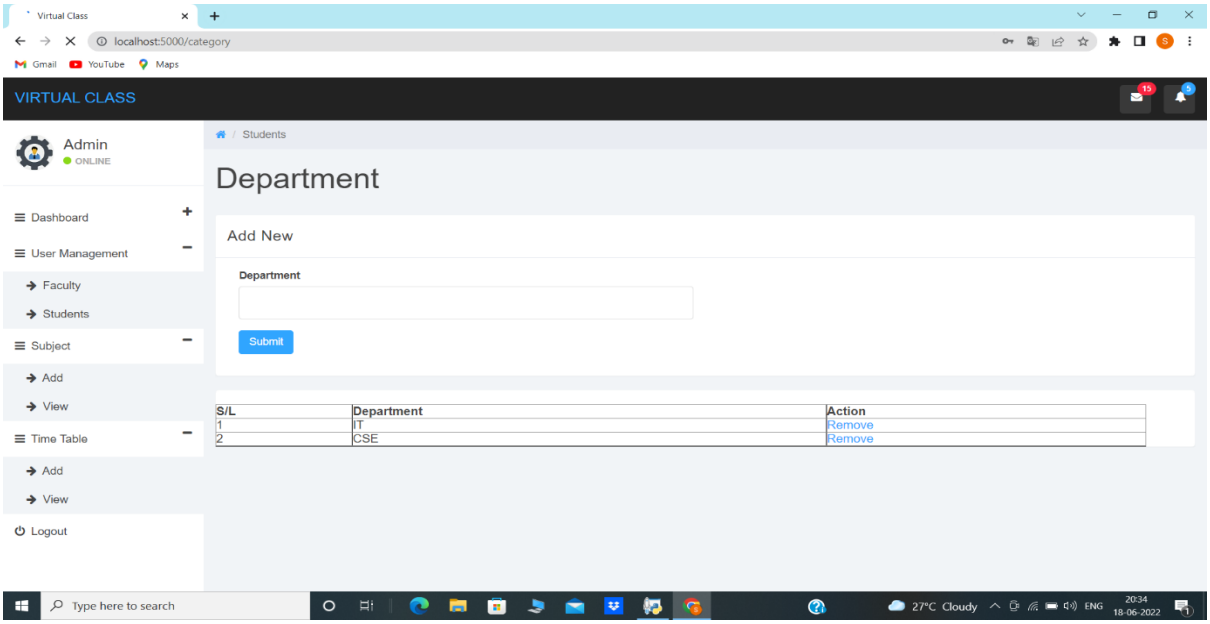
```
value4 = mycursor.fetchone()
idd=value4[0]


mins=value4[4]
num_mins=mins+1
stm=value4[3].split(':')
etime=""
#############3
h1=int(stm[0])
m1=int(stm[1])
m2=num_mins
m3=m1+m2
if m3>59:
    d1=m3/60
    d2=int(d1)*60
    d3=int(d1)+h1
    if d3>23:
        hh=24
        d3=d3-hh
    d4=m3-d2
    etime=str(d3)+":"+str(d4)
    print(etime)
else:
```

```
            etime=str(h1)+":"+str(m3)
            print(etime)
        ##########

        mycursor.execute("SELECT * FROM ci_user where uname=%s",(staff, ))
        value33 = mycursor.fetchone()
        tot=value33[9]

        mycursor.execute('update ci_time set
etime=%s,num_mins=%s,tot_time=%s WHERE id=%s',(etime,num_mins,tot,idd))
        mydb.commit()
```

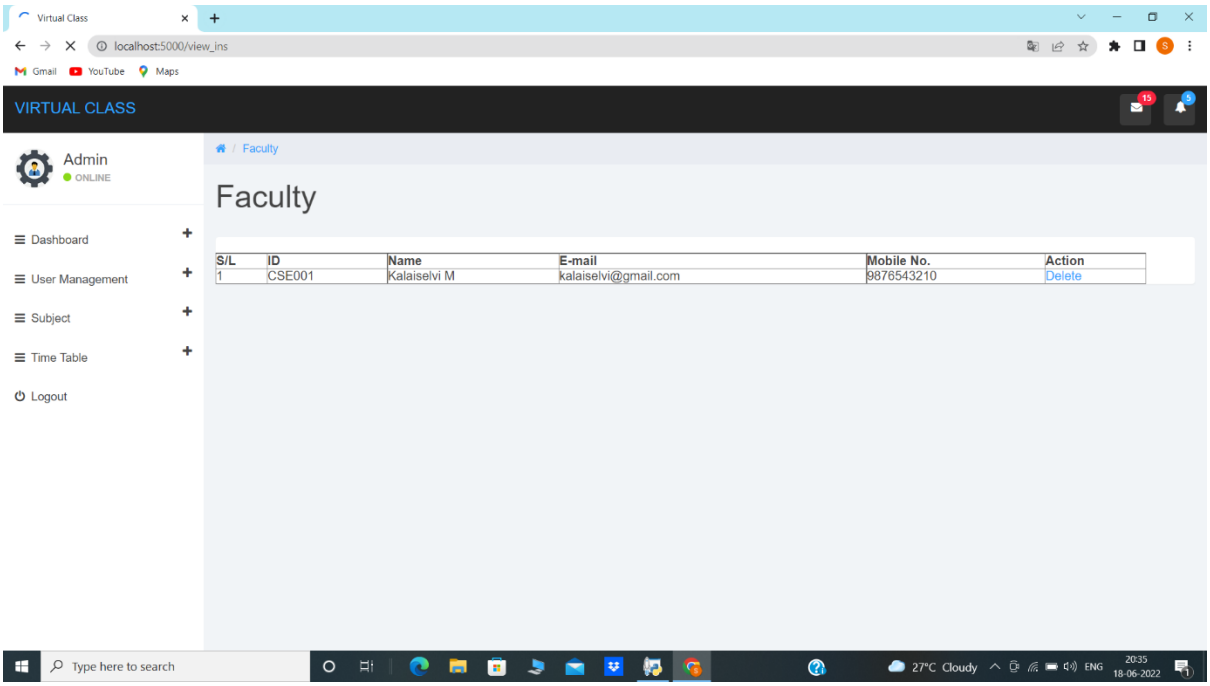
APPENDIX B (SCREENSHOTS)



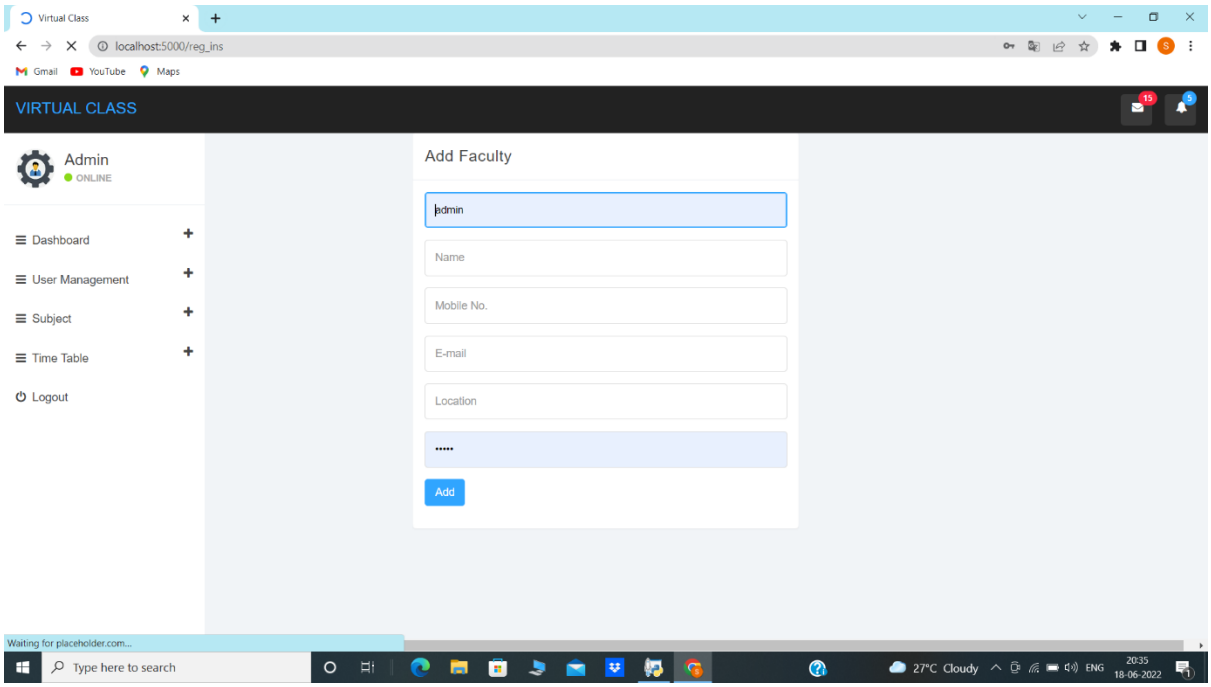
Admin login



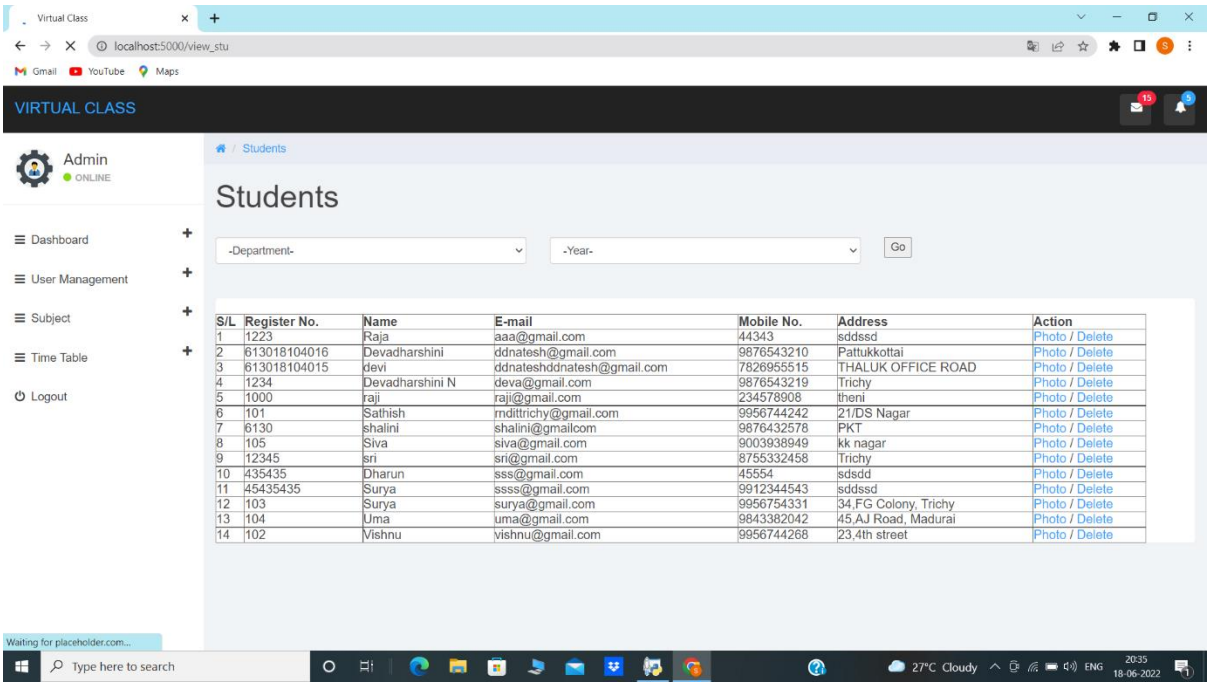
Departments



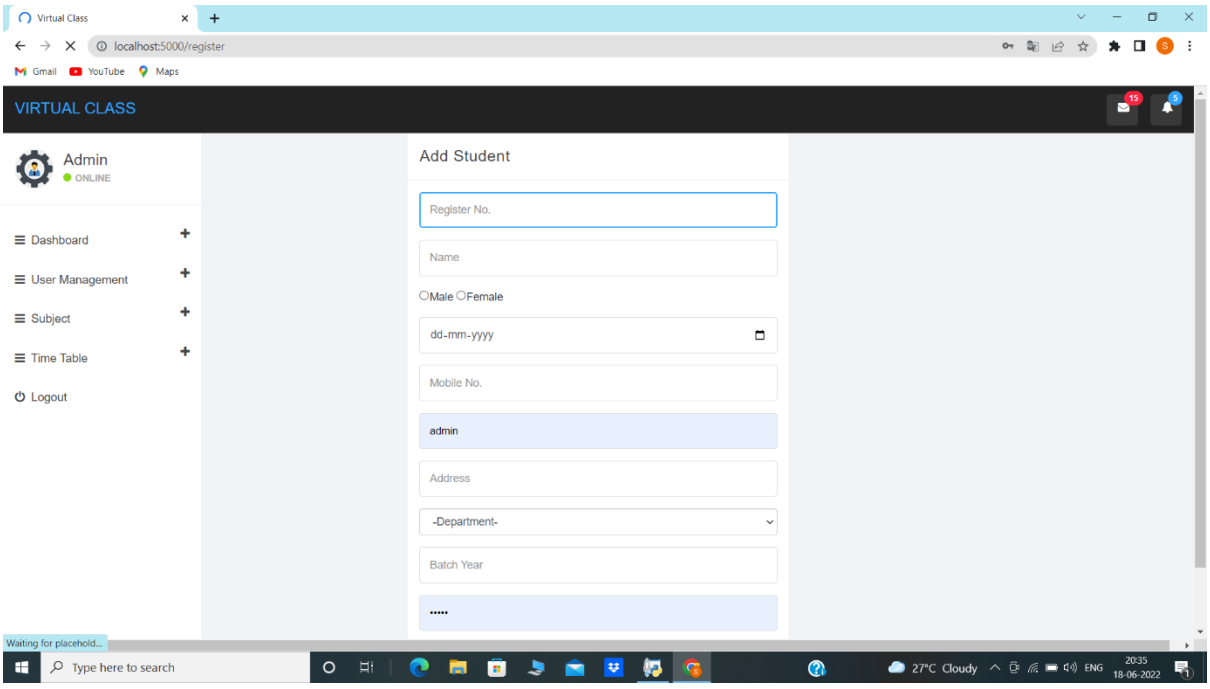
Faculty Details



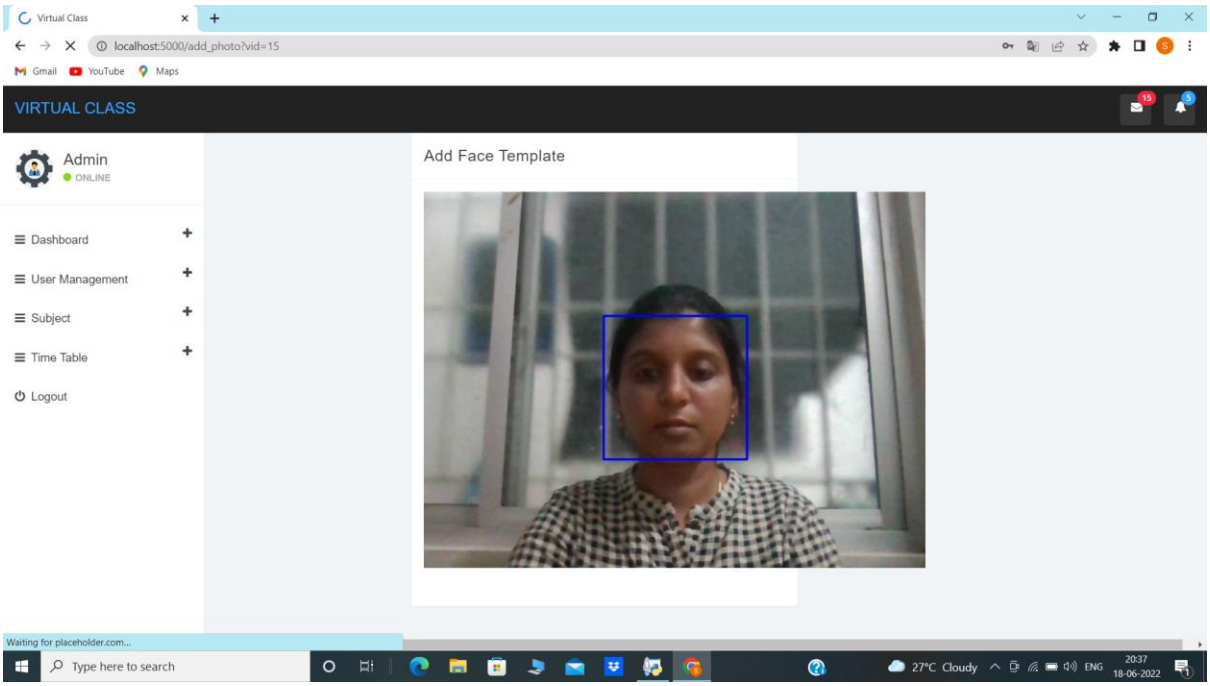
Add faculty details



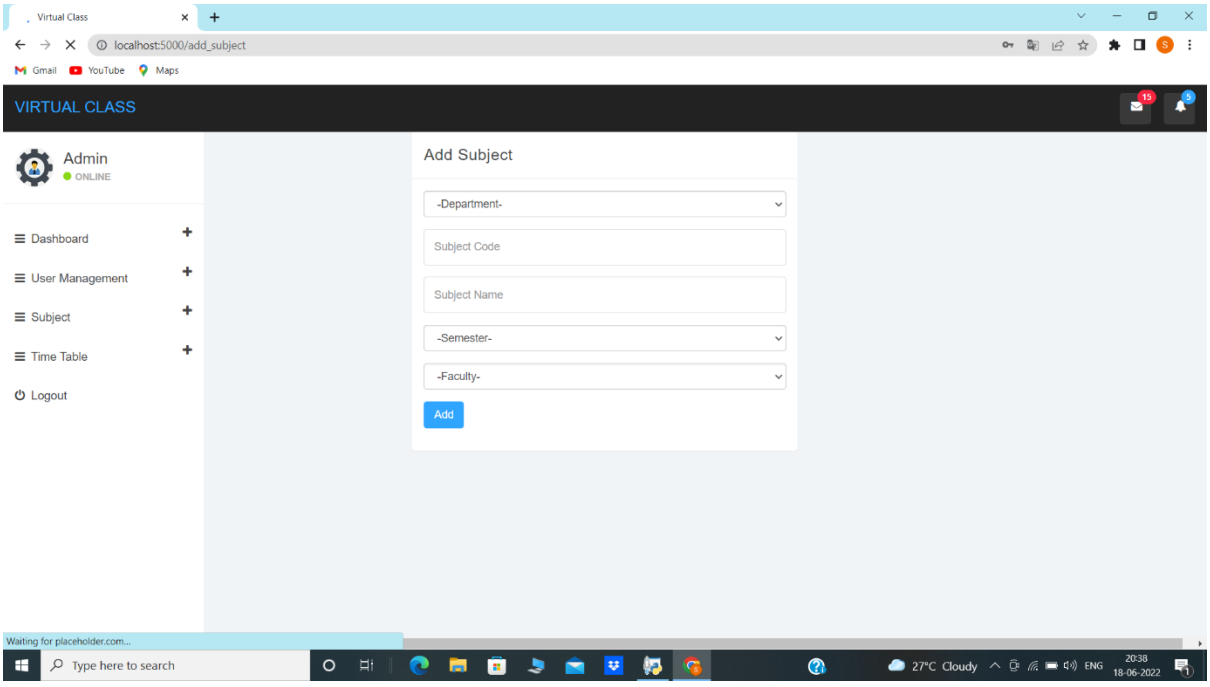
Student Details



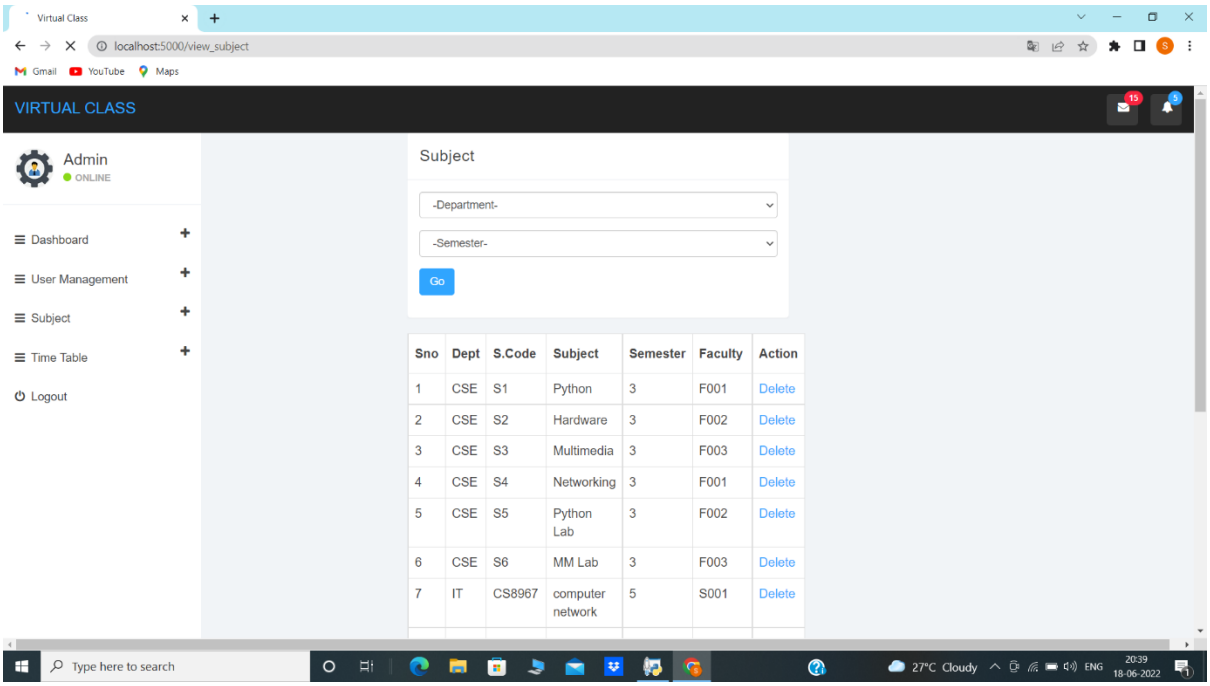
Add Student Details



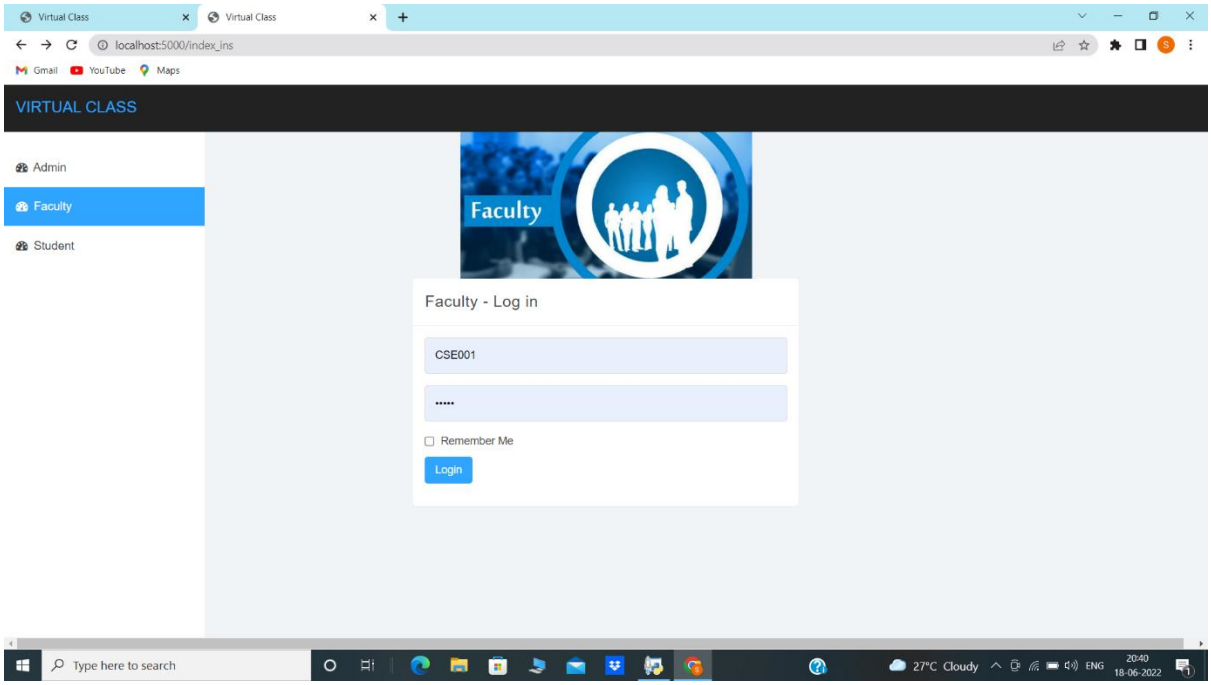
Add Face Template



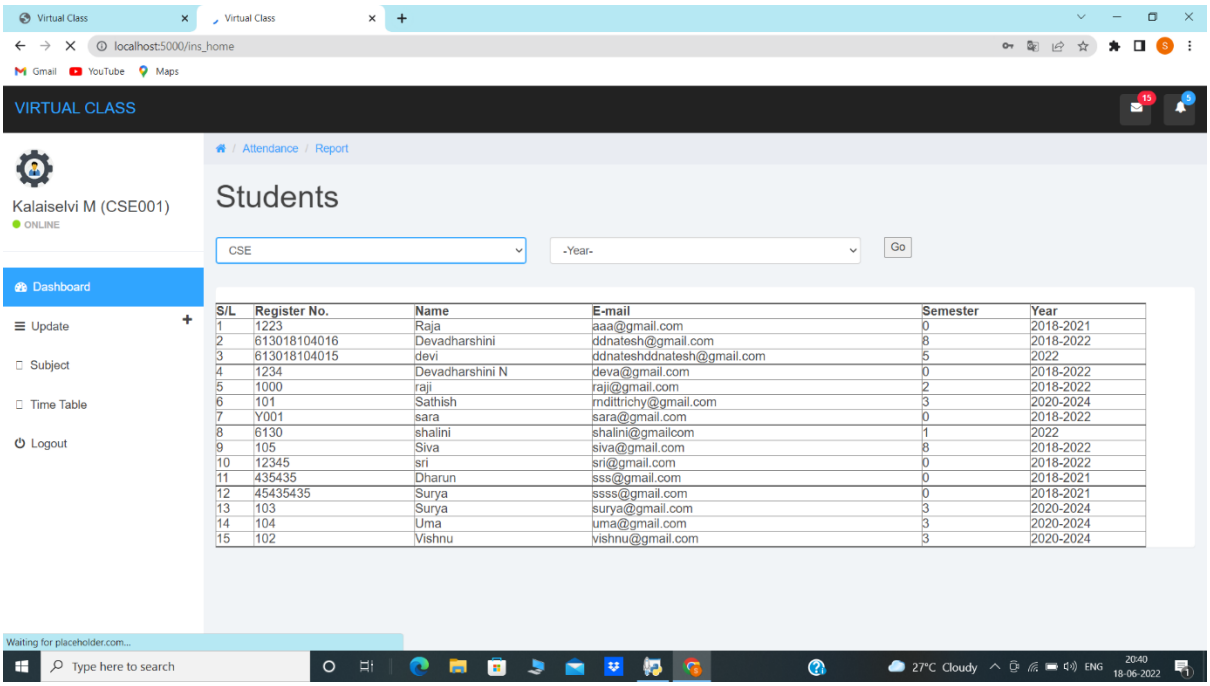
Add Subject Details



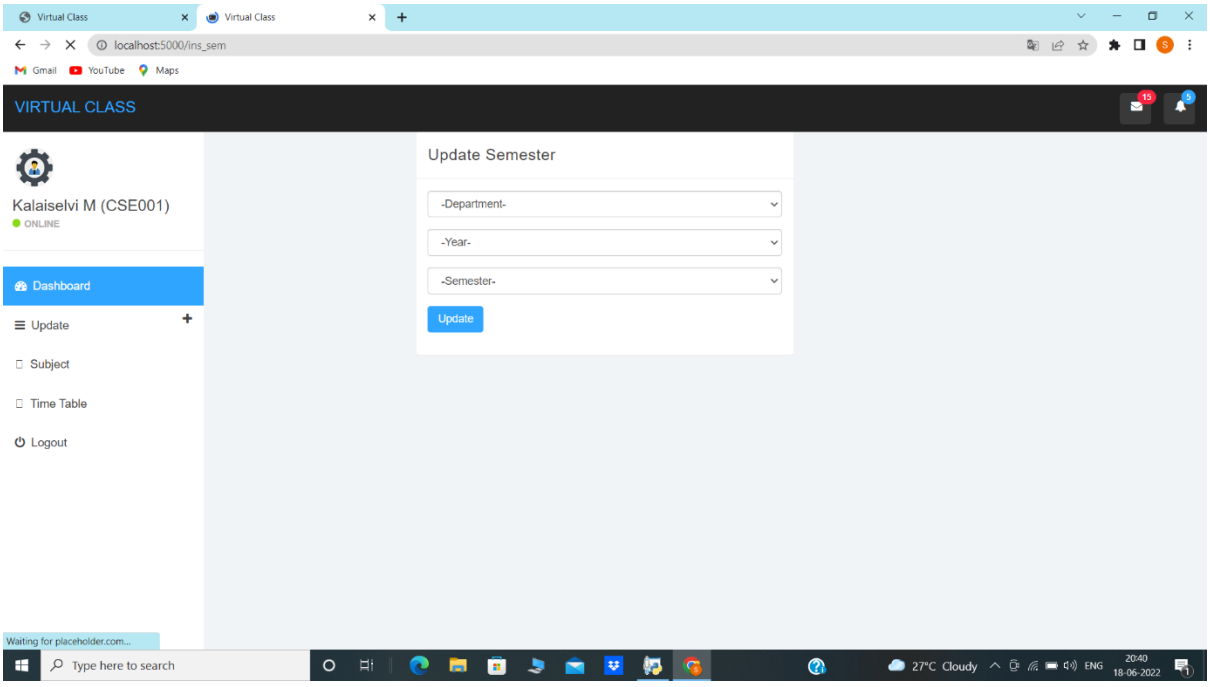
Subject Details in Admin page



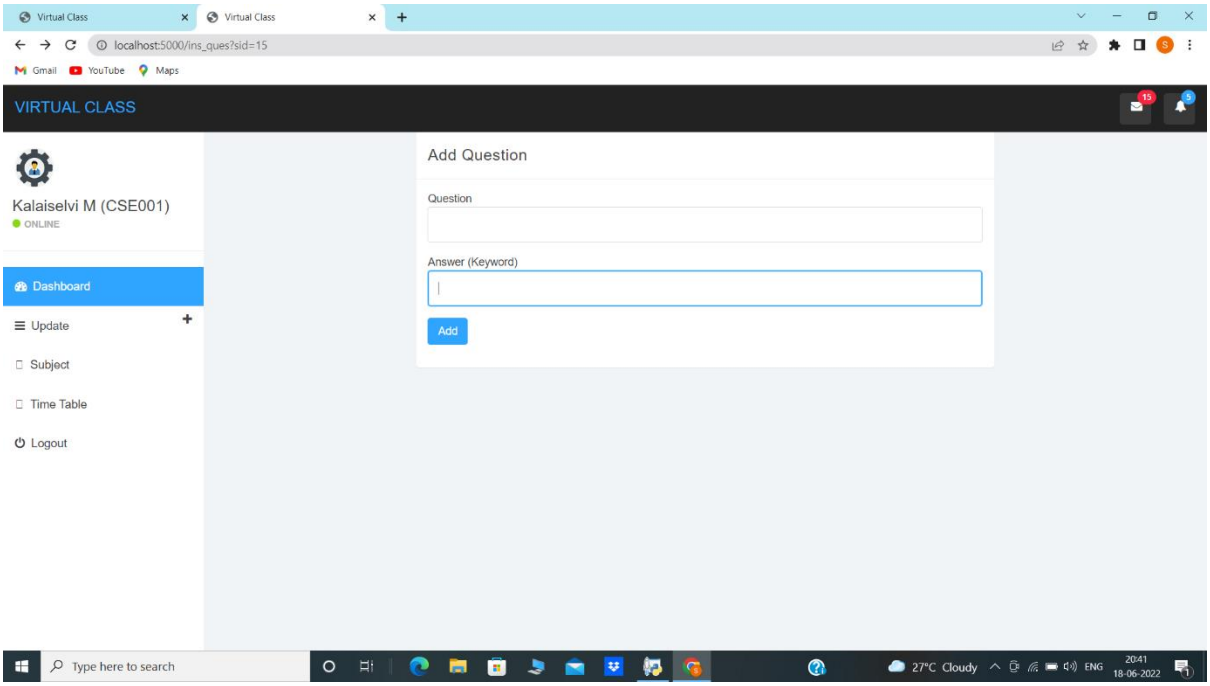
Faculty login



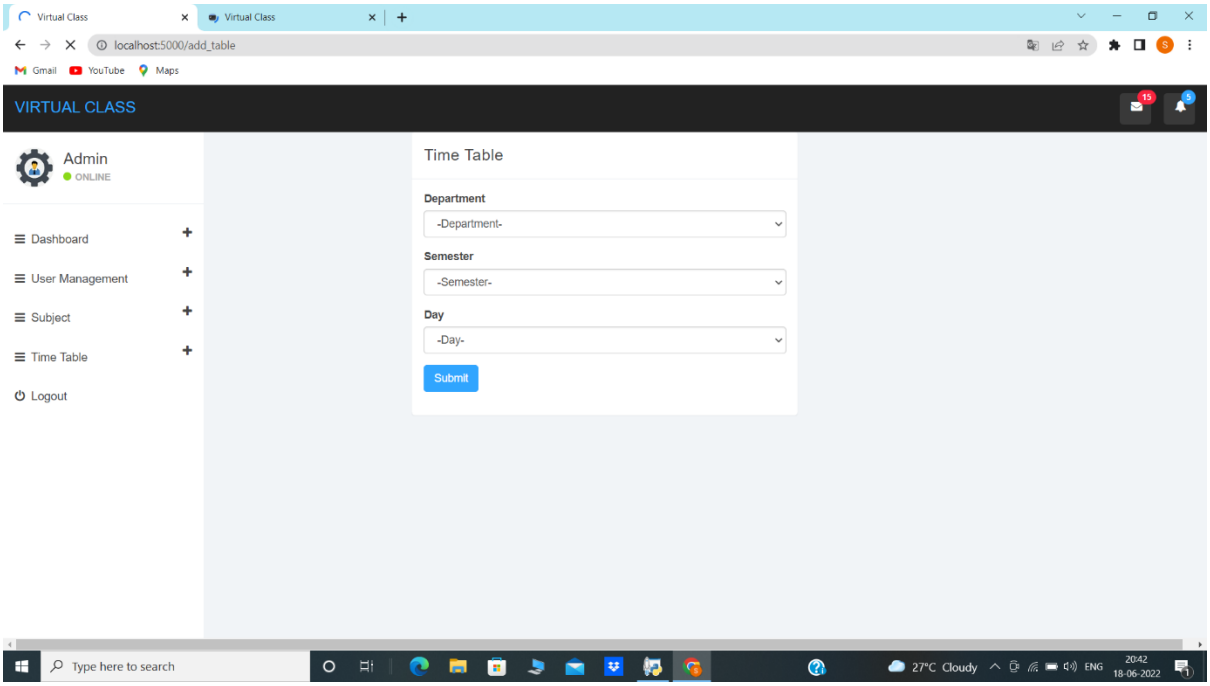
Students Details in Faculty Page



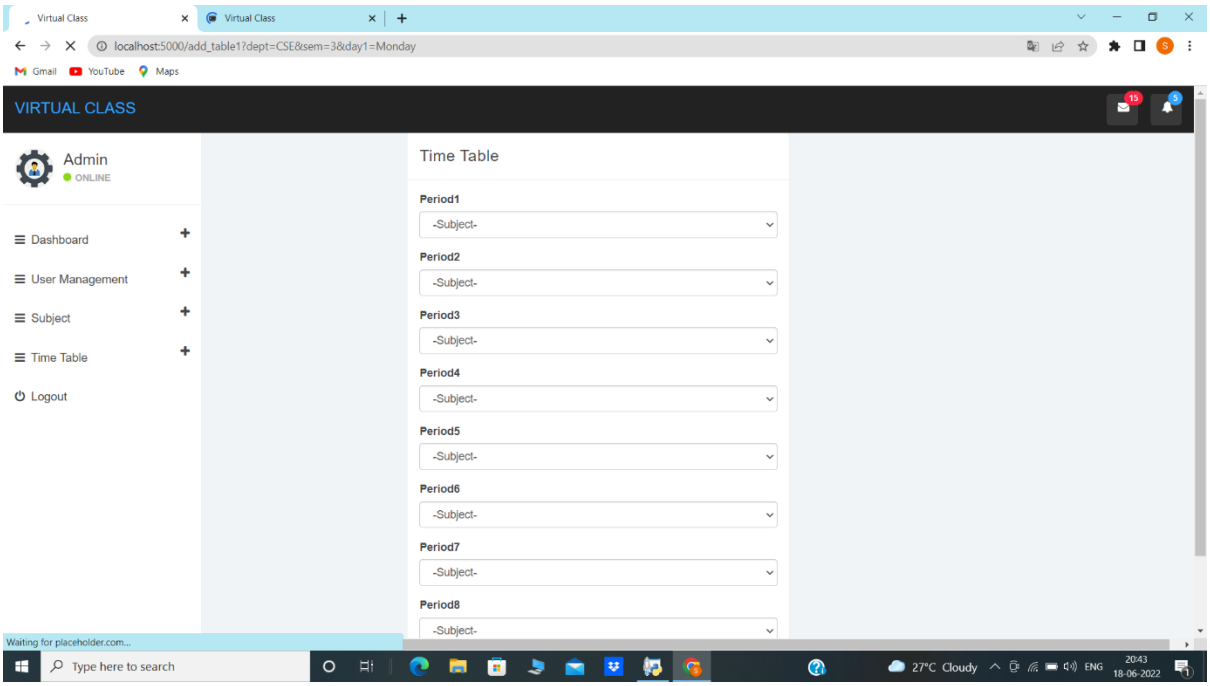
Update Semester



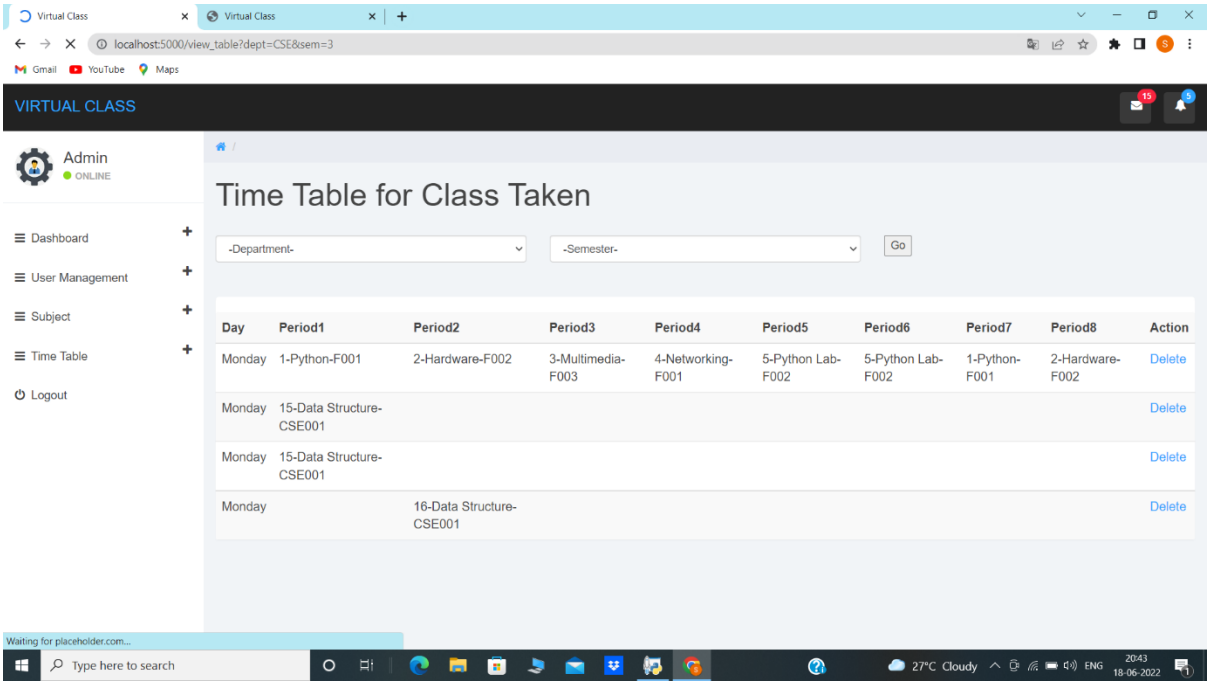
Concept QA by Faculty



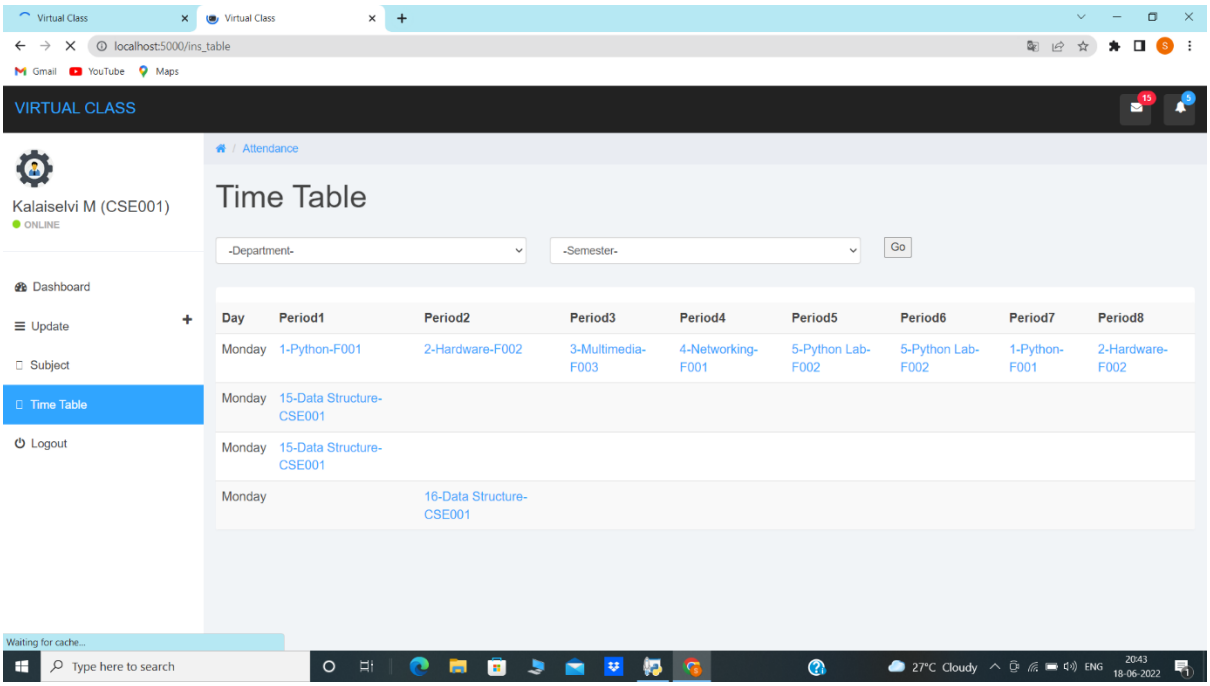
Adding Time Table by Admin



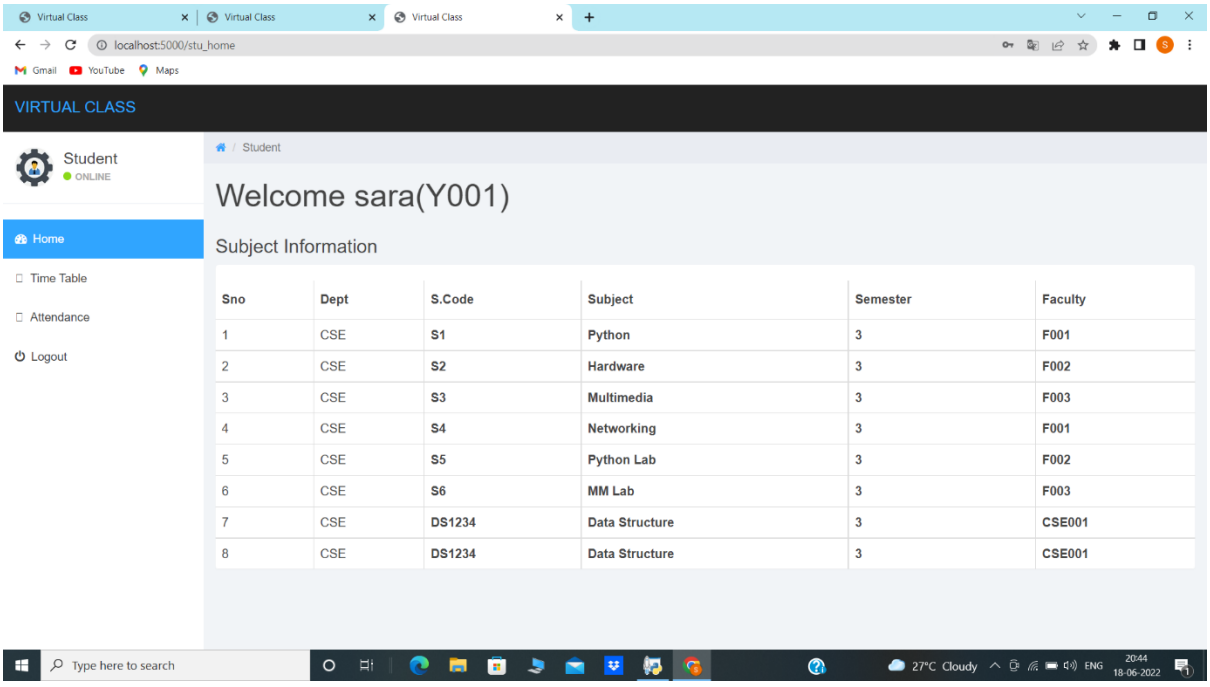
Update Subject Timing



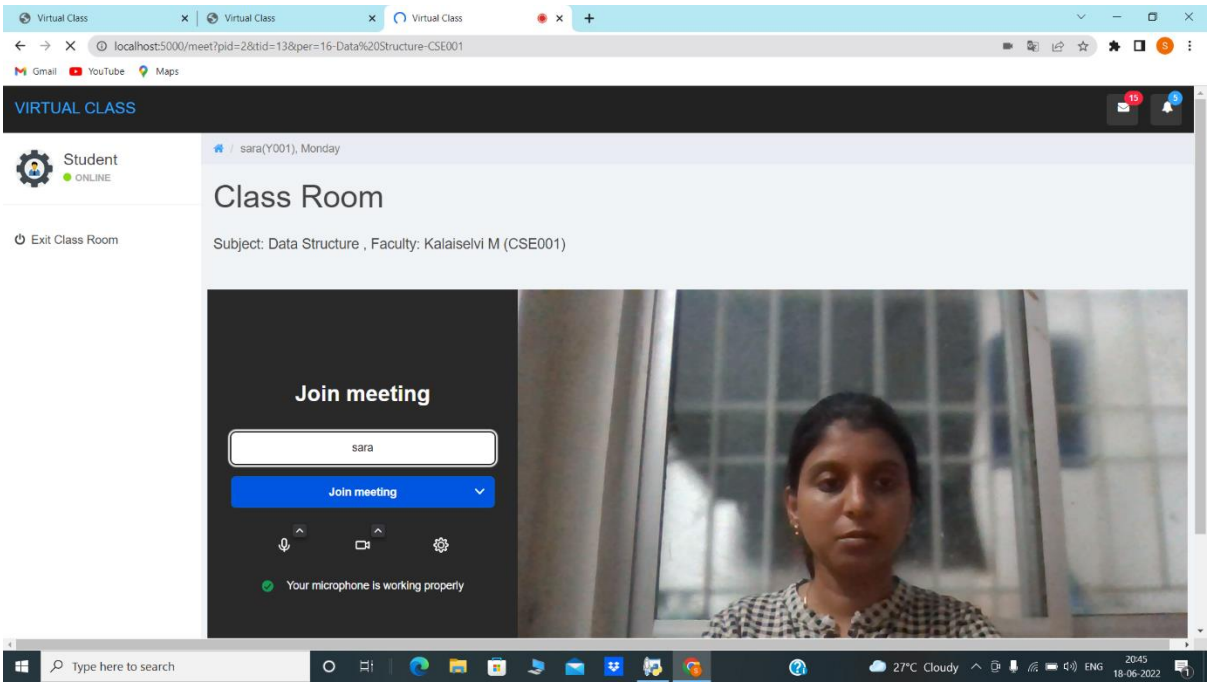
Time Table for Class Taken



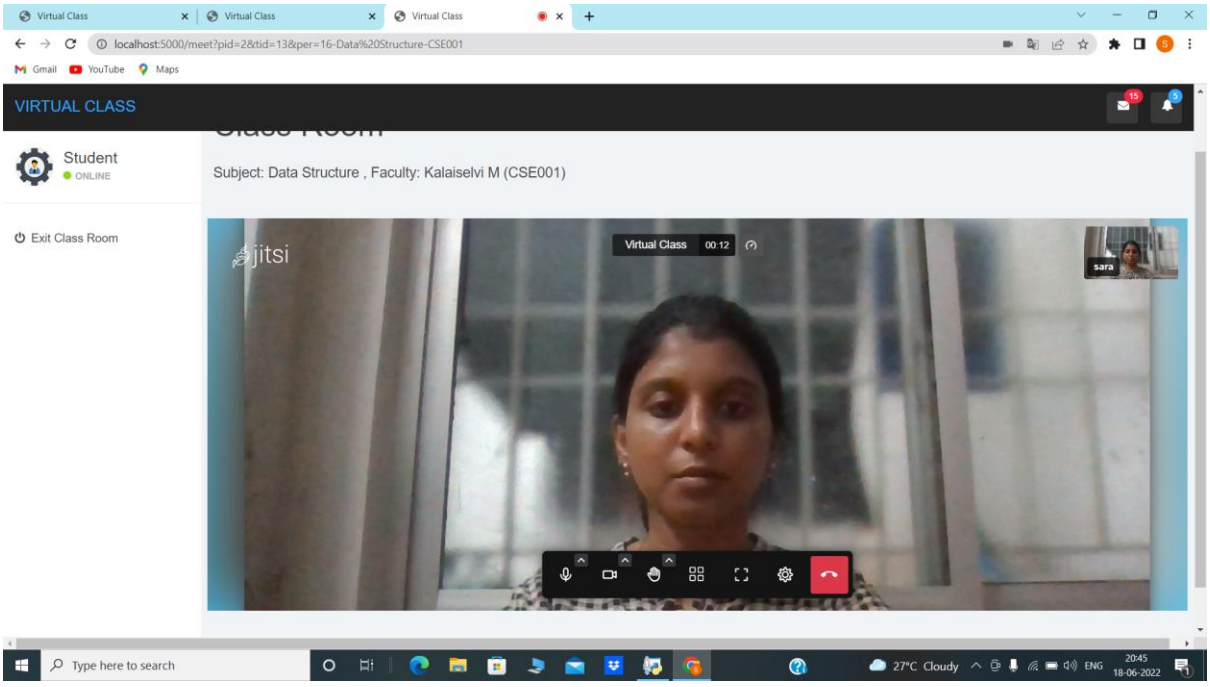
Time Table in Faculty Page



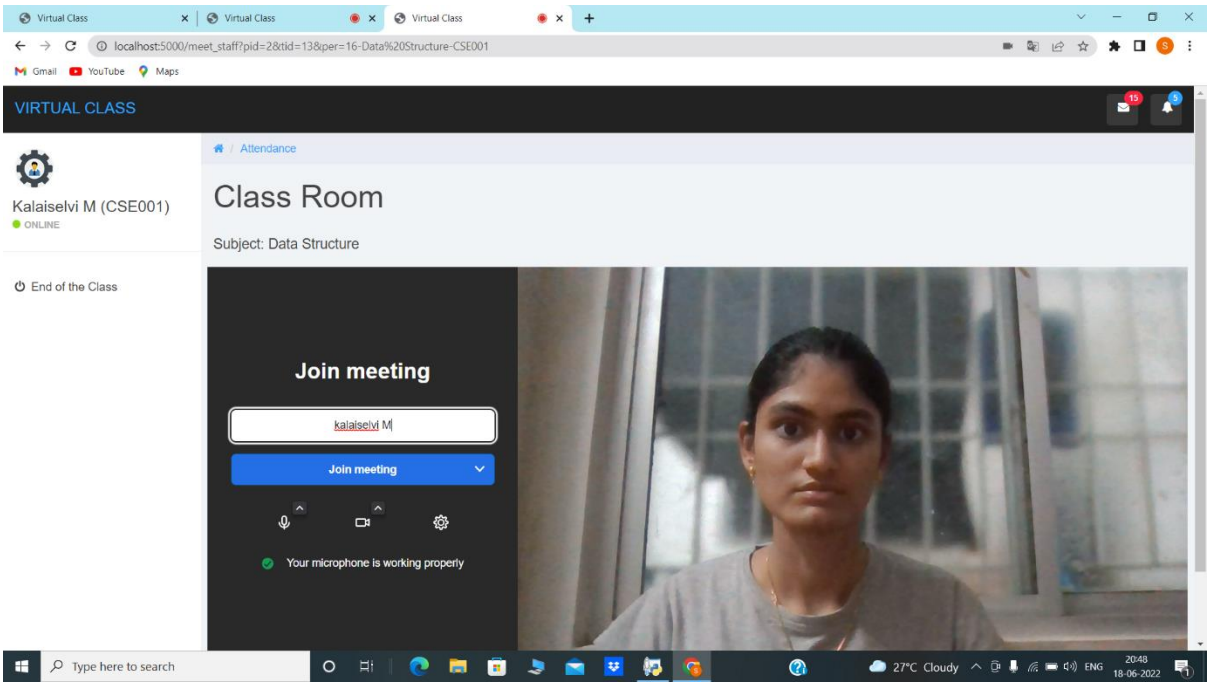
Student Welcome Page



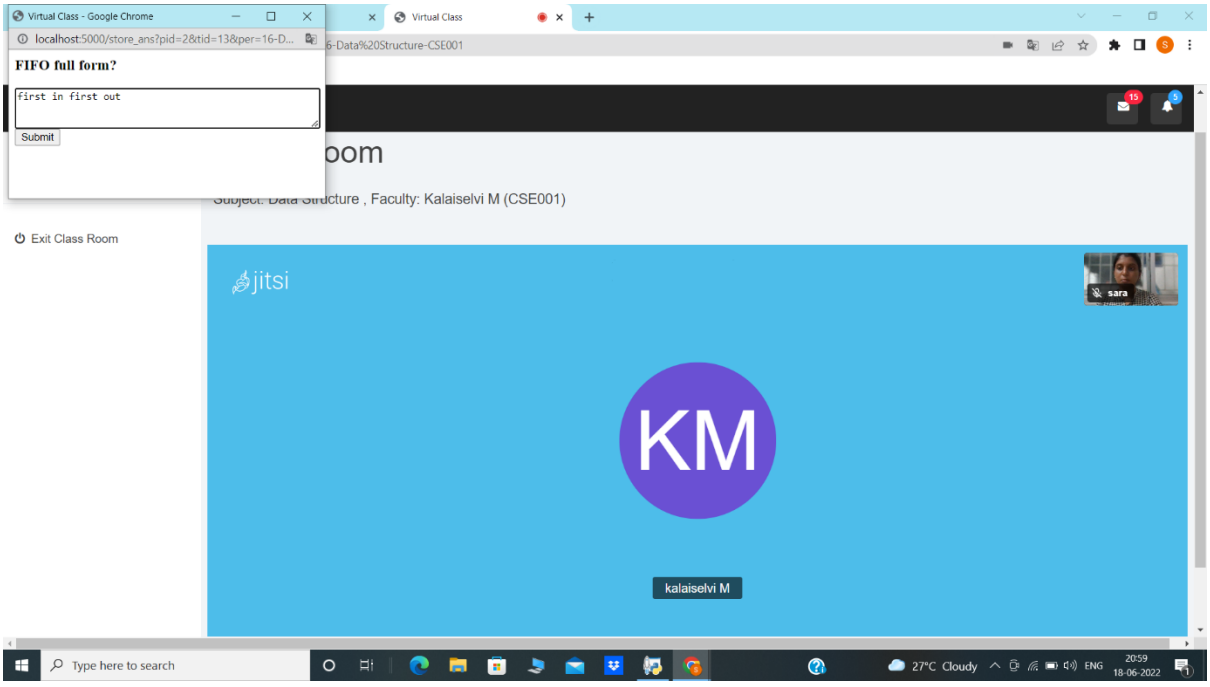
Student Joining in the Class



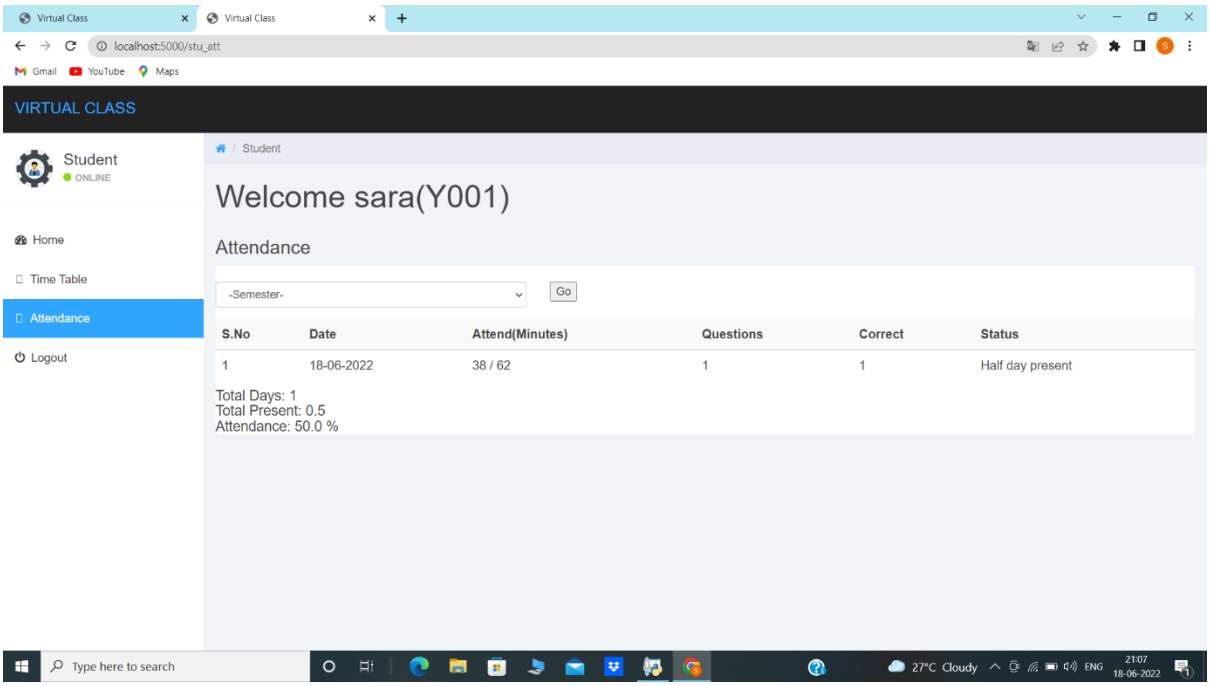
Student Joined in the Class



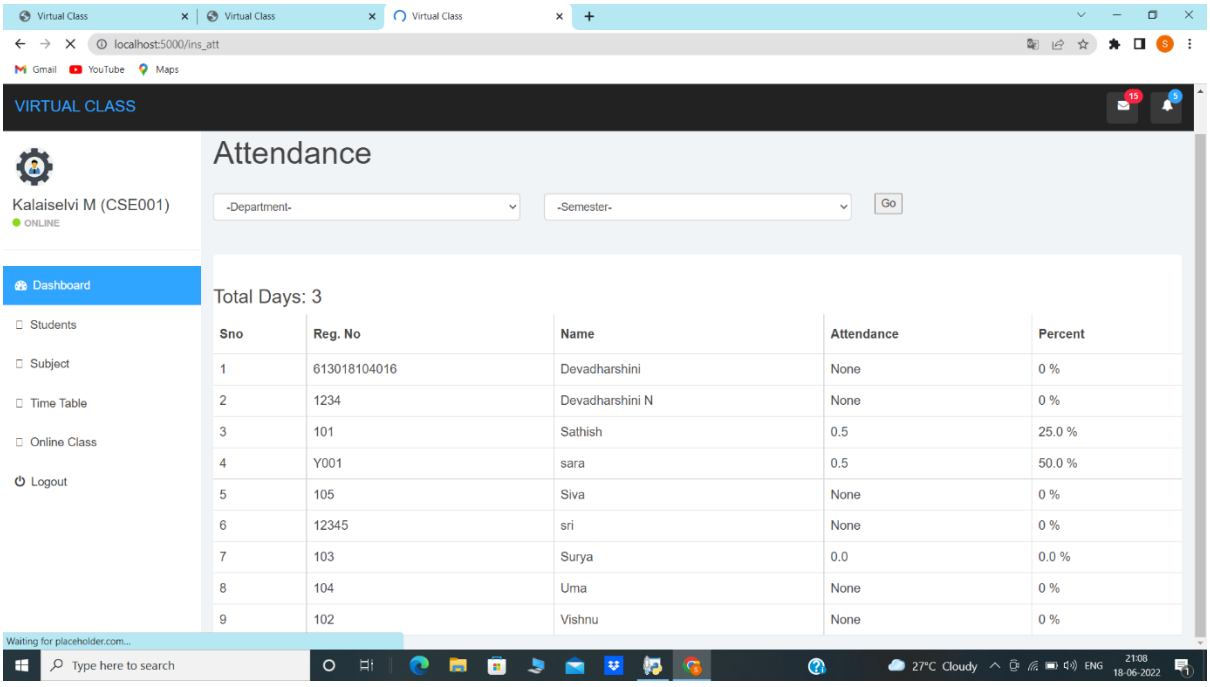
Faculty Joining in the Class



Concept QA in between the Class



Attendance Page in Student Login



Attendance Page in Faculty Login

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