Project Report

on

Online Examination Proctoring System Using Artificial Intelligence

Submitted to

Sant Gadge Baba Amravati University

In partial Fulfillment of the Requirement

For the Degree of

Bachelor of Engineering in

Computer Science and Engineering

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CERTIFICATE

This is to certify that **Ms. Divya Agrawal, Ms. Radhika Maloo, Ms. Shachi Chaware, Mr. Suved Bhagwat** and **Mr. Tanishq Nanda,** students of final year B.E. in the year 2022-23 of Computer Science and Engineering Department of this institute has completed the project work entitled "Online Examination Proctoring System using Artificial Intelligence" based on syllabus and has submitted a satisfactory account of his work in this report which is recommended for the partial fulfillment of degree of Bachelor of Engineering in Computer Science and Engineering.

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Internal Examiner **External Examiner**

Date: **Date:**

ABSTRACT

The ability to efficiently proctor remote online examinations is an important limiting factor to the scalability of this next stage in education. Presently, human proctoring is the most common approach of evaluation, by either requiring the test taker to visit an examination centre, or by monitoring them visually and acoustically during exams via a webcam.

In online education, monitoring the attendance of the students is very important as the presence of students is part of a good assessment for teaching and learning. However, such methods are labour-intensive and costly. As well as a new trend of Massive Open Online Courses (MOOCs) which offer a student to expand the reach of his creativity and knowledge by registering in these courses. Instead of traditional classroom teaching a student can take a course from anywhere in the world using a computer.

The certificates for MOOC should be provided after the student gives a proctored examination. Hence some kind of online portals are needed for a trustworthy proctoring of online examination Our portal will help in automating the proctoring the online examinations. This portal will track the exam givers – eye ball movement, lip movement, audio tracking, phone detection, person counting.

Keywords: Proctoring System, Convolutional Neural Network(CNN), Online Examination System, Remote Proctoring

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Abbreviations

CNN	Convolutional Neural Network
DNN	Deep Neural Network
PSAI	Proctoring System using AI
BP	Back Propagation
GD	Gradient Descent
MSE	Mean Square Error
RL	Reinforcement Learning
tanh	Hyperbolic Tangent
ReLU	Rectified linear Unit

CHAPTER 1
INTRODUCTION

1.1 Preface

Any program of studies must have exams, and online learning programmes are no different. Every exam has a tendency for cheating, hence its recognition and avoidance are crucial. For educational qualifications to remain valuable to the community, they must demonstrate true learning. To protect the integrity of the assessment process, traditional exams and tests must still be taken in supervised settings, within designated exam hall, with physical examiner present. As a result, both the institution and the candidate are forced to choose an expensive model. While some students may find this to be less of an issue because they are physically present in class, an increasing portion of the industry is focused on the remote offering of every course. In many cases, even if their professors may be thousands of miles away, students still must make their way to testing facilities to take their tests.

In accordance to a report by UNESCO Instructional Distortion and Reaction to the pandemic of COVID-19, a large number of governing bodies globally are shutting down educational organizations and considerably moving their activities to online and mobile modality, which will effect more than 89% of the global population of students.The models that are used for proctoring are still very important, as is the level of evaluation done to stop mistakes in remote settings. This study contains high-level similarities of flagging, removing, and detecting anomalous activity in addition to strengthening false positives till notable accuracy is attained. While this kind of system supports the use of numerous recognition processes, including those for facial detection, Sound detection, Eyeball movements recognition, Change of tabs detection, Device finding, and others, it is frequently the case that any or all of these mechanisms, when combined, can improve the equality of an investigation, give it greater trust and honesty, and assist in avoiding not being repudiated.

How does an online proctored exam work?

The candidates appearing for the online proctored examination are required to download the software application onto the device (laptop or desktop) that will be used for the purpose. When the candidate begins the examination, the application assesses his/her computer and webcam and a lockdown mechanism is used to prevent him/her from opening any web browsers. The candidate has to confirm his/her identity by one of the many methods that are required by the application. While few may require the candidate to show proof of identity to the camera, some others use facial recognition software to confirm the candidate’s identity.

Once the exam begins, there are three ways in which online proctoring can take place: Live online proctoring, Recorded proctoring, and Advanced automated proctoring:

Live online proctoring:

In this form of proctoring, a qualified proctor monitors the candidate as he/she is giving the exam through live audio and video feeds. These proctors are trained to ensure the authenticity of the candidate and look for any red flags such as suspicious eye or facial movements or the appearance of any unverified device that could indicate possible cheating. In case suspicious circumstances do arise, the proctor can either shut down the test or notify the company of the prohibited activity. This form of proctoring allows the proctor to monitor up to 32 (a standard number for most proctors) candidates at a time. Both the candidate and proctor can be in any location as long as they both have access to the internet. However, the only disadvantage of this kind of proctoring is that it is dependent on the availability of the proctor on a given date and time. It is also expensive since it needs human intervention just like offline proctoring and for the same reason is not scalable either.

Recorded proctoring:

Unlike live online proctoring, a recorded proctoring, as its name suggests, merely records the activities of the candidate during the examination, which is then played back by a proctor at the greater speed to look for any suspicious behavior or occurrence during the course of the exam. This form of proctoring has an advantage in that it requires no scheduling since the candidate can take the exam at any time convenient to him/her. But as this too requires human intervention for reviewing the clip, it is expensive and difficult to scale.

Advanced automated proctoring:

This is the most advanced form of proctoring (as the name suggests) and requires no manual intervention whatsoever. This form of proctoring records the activities of the candidate while also monitoring the feed for red flags of any sort that would indicate malpractice using advanced audio and video analytics. It is the least expensive of all these forms of proctoring since it eliminates the need for manual intervention and is scalable for the same reason.

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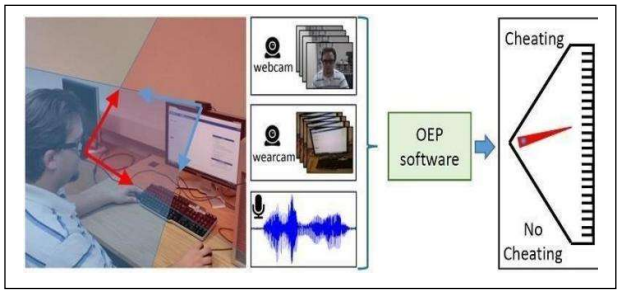

Fig. 1.1.1 Online Proctoring System

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1.2 PROBLEM STATEMENT

The ability to efficiently proctor examinations is an important limiting factor to the scalability of this next stage in education. In online education, monitoring the actions of the student is very important.

1.3 OBJECTIVE

- Locating a suitable dataset.
- The data is being preprocessed.
- Model training and testing.
- Determining the model's accuracy

1.4 SCOPE OF PROJECT

1. Advanced monitoring: This System can be used to monitor the students during the exam and detect any suspicious behavior or activity, such as using external devices or communicating with others
2. Intelligent authentication: AI can be used for secure authentication and verification of the students taking the exam, ensuring that the right student is taking the exam.
3. Data analysis: AI can analyze the data collected during the exam, such as the students' responses and the time taken to complete the exam, to provide valuable insights into the effectiveness of the exam and the students' performance.

1.5 ORGANIZATION OF PROJECT

Chapter1: It gives an Introduction of the project.

Chapter2: Literature Survey of the research papers referred to get an idea of the previous work done on this project.

Chapter 3 : Analysis Of the Problem Statement

Chapter 4: Design of the Project

Chapter 5: After reviewing, the methodology of how the project can be executed.

Chapter 6: How the project was implemented

Chapter 7: Output and UI screenshots

Chapter 8: The conclusion derived from project

Chapter 9: Future Scope

- Details of the Research Paper Published

CHAPTER 2
LITERATURE SURVEY

2.1 RELATEDWORK

The need for online education has grown dramatically over time. Researchers have suggested a number of strategies to efficiently and conveniently proctor online tests while maintaining academic integrity[1]. The absence of proctoring does not give test-takers licence to cheat. Contrarily, there are many techniques to minimise cheating. The authors of [3] contend that by offering eight control techniques that let teachers make exams more challenging and hence less likely for students to cheat, they may encourage academic honesty. The authors provide network design and a safe web-based test system. Using a binary SVM classifier, the audio wavelength is divided into 16 separate pathways, and voice is considered an optimistic sample.One of our novel ideas is to use CNN algorithm is that they are very accurate at image recognition and classification.

One popular method for proctoring online tests is through online human supervision. The biggest drawback is that it is quite expensive because numerous staff are needed to monitor the test-takers. Additionally, researchers have suggested several comprehensive monitoring techniques, such as in [4], where they employ snapshots to lower the bandwidth cost of broadcasting huge video data.A novel alignment technique based on an ensemble of regression trees that selects shape-invariant features while minimising the loss function we wish to minimise at test time during training. Results, both quantitative and qualitative, are presented that demonstrate how much more effective our method is than the best preceding method at producing high-quality forecasts. The system will record audio from the microphone and convert it to text using Google's speech recognition API, to remove stop words from it.But in our project we used NLTK. The preferred Python API for NLP (Natural Language Processing) is (Natural Language Toolkit). To prepare text data for subsequent analysis, such as with ML models, it is a very potent tool. It assists in turning words into numbers, which the model can use to its advantage.

The study by N.L. Clarke and P. Dowland presents a useful idea for enabling mobile and digital proctoring while students are taking exams [3]. The method uses transparency identification to provide a consistent, unobtrusive identification of the

student's existence throughout the exam. An analysis of the platform's innovation is utilised to develop a model that demonstrates the effectiveness of this tactic.The method used Caffe Model of Open CV's DNN Moduleand the drawback of this method is that the movement of head or different camera positions can cause changes of facial texture and it will generate the wrong result, butin our project we used CNN algorithm for better accuracy.

AsepHadian S. G and Yoanes Bandung employ an innovative technique where user identification is given major significance on a consistent scale in [6]. Using a large database of user photographs, CNNs are taught to identify users in low-light conditions and generally. The CNN has been able to learn the values by utilising classifiers that highlight traits that require nonlinear mapping. The false acceptance rate and false rejection rate from the confirmation method are used to calculate the system accuracy rate at the final assessment step. The novel thing we did inour project is we used Django which gives us accuracy to our model.

In [7] by Aiman Kiun, the emphasis is on using convolutional neural networks to spot phoney behaviour in test video clips. Rectified activation units were utilised by the image filtering models, which in turn produced excellent results for big data sets. Their system included a user interface, video editing, and image classification.The interface will unavoidably upload the students' exam-taking video into a series of processes in a pipeline. Since the applicant photographs were already part of the scrutinising collection, the enormous recorded would be reduced to a small number of minimalist images, and some duplicate or similar-looking frames would be removed. The workload of the proctoring setup would decrease as a result.

One of our novel ideas is to apply our proctoring system to Google Form and Teams Form. Among all prior work applying proctoring system to Google form and MS teams is not possible. By applying this proctoring system to such forms, the cheating behaviour of students is decreased while the integrity and degree of freedom is also achieved.

CHAPTER 3
ANALYSIS

3.1 PROBLEM ANALYSIS

One major consideration to be made when designing any software is of the issues which may occur at any stage of execution. For any proctoring software, we must primarily consider two factors where a user may face problems: technological and human response.

A major Security factor which can be misused easily is user privacy. Since, user authentication is necessary before allowing the student to attempt the exam; they are required to verify their personal details to the proctor. This can be done by scanning their User Identity Cards like College ID, Aadhar Card. Such documents are often linked to sensitive user details and can be misused easily. The mobile numbers linked can also lead to phishing calls and serious offences like catfishing, harassment and so on. A proctor may end up indulging in immoral activities with the information at hand. Hence, a lot of emphasis must be given to ensuring that any Proctoring Software is robust, secure and ensures privacy of the test-taker.

Impersonation by candidates is another security flaw which needs to be avoided. Since Proctoring Software give us the liberty to attempt any exam at home, this facility can be misused by users as they may make any other person attempt the test using their credentials. User Authentication, therefore, becomes a necessity before permitting anyone to begin with the exam.

For ensuring fair assessments, various security measures are applied by Proctoring software. Some applications involve gaining control of the candidate's device. This includes webcam, microphone and even gaining screenshare access of the Desktop/Laptop/Mobile. Such level of control over a device can lead to numerous privacy problems and makes the device more susceptible to hacking attacks. Any Proctoring System must ensure that the device security is ensured using various Security Protocols and the data being stored at their data centers is well-protected from malware attacks.

Proctor Authenticity is one important aspect which should not be neglected. Since the proctors are hired separately by the companies providing the solutions and not the

organizations which administer the exams, steps should be taken to ensure that well-qualified people are given the role after rigorous interviews and relevant background checks. Presence of any miscreant as a proctor can be harmful for the candidate's safety and privacy as the details at their disposal can be misused and lead to dire consequences. Both the organization and the company involved will face negative reviews in public which will be a great deterrent to their future prospects.

Proctoring Systems also have to deal with and work around several infrastructure issues. Since their main goal is to ensure fairness and closeness to offline pen-and-paper exams, they require certain minimum specifications and hardware components to be present in devices of all candidates who are going to avail their facility. Implementing a combination of Artificial Intelligence and Human Proctoring inadvertently increases the cost for the company delivering the software. Doing cost-analysis is integral to ensure that the entity doesn't become a loss-making proposition but is instead a sustainable venture.

The IP Addresses of candidate's devices (Both Desktops/Laptops and Mobile Phones) are accessible by several software to prevent misconduct. However, they can be easily manipulated nowadays using VPNs which cannot be tracked easily. This can be misused by candidates to indulge in malpractices which dilutes the efficiency of the application.

Candidates' devices need to have certain minimum specifications like a working webcam and microphone, certain free storage in RAM. They also need to give control access to proctors and need to ensure an efficient internet bandwidth. All this has to be working throughout the duration of the examination. Failure of any one of these components leads to the examination getting temporarily suspended until they are fixed and working again. Any candidate who goes through these issues has to shift his/her focus from the exam towards fixing the problem which isn't ideal in such a stressful scenario.

The Interface of the application also needs to be not too complex but rather easy to understand. When we consider various National/International level exams, people from all sections of society appear for them. Many of them cannot afford to own such

devices and hence, they end up without an opportunity to appear for the examinations. A complex User Interface also ends up perplexing candidates even before their exam has started which isn't ideal.

The logistics of setting up data-centers to store candidates' personal information as well as examination data isn't cheap either. Any exam is given by thousands of people together at any given time. Hence, robust servers need to be created and used so as to ensure that no candidate faces any technical issue from the server-side of the application. Low internet connectivity can also lead to problems during the exam and hence, arrangements need to be made to ensure a stable network connection.

Apart from the above technical factors, we also need to consider issues pertaining to human psychology and other socio-cultural factors like acceptance of the new methodology. Various studies have been conducted to test how cheat-proof any proctoring software is. A common theme has been observed in the results where candidates end up scoring more marks in an online exam compared to an offline. Inflated marks can be deceptive for not only outsiders but even the candidate who scores them since they may get an impression of possessing abilities to an extent within them which is not the case in reality. Making any proctoring software cheat-proof has to be the first priority for any company to ensure they replace pen-and-paper based examinations in the future.

E-Proctoring is expensive to implement and has to respect a candidate's autonomy and liberty. Trust is an important aspect during examinations for both the examinee and the examiner. Flagging any candidate inappropriately of indulging in wrongdoing can be detrimental for them. It will also not be correct on the proctor's end to miss out on obvious evidences of cheating.

3.2. REQUIREMENT SPECIFICATION

3.2.1 SOFTWARE REQUIREMENTS

- VS CODE EDITOR
- GOOGLE CROME BROWSER
- MYSQL DB
- INSPECT TOOL

3.2.2 HARDWARE REQUIREMENTS

- Minimum 8 GB RAM
- Minimum Intel i5 processor
- Keyboard, Mouse, Screen
- Minimum 80GB HDD
- Camera
- microphone

3.2.3 TECHNOLOGIES REQUIREMENTS

- PYTHON 3
- HTML, CSS
- PyAudio
- NLTK
- Django
- Java script

3.3 FUNCTIONAL REQUIREMENTS

functional requirements defines a function of a system or its component. A function is described as a set of inputs, the behavior and outputs. Basically requirements are statements that indicate what a system needs to do in order to provide a capability.

- the system must be able to detect any kind of audio and video based malpractice

- the system must send proper warning message
- the system must authenticate the person correctly
- the system must log out successfully when required

3.4 NON- FUNCTIONAL REQUIREMENTS

The non functional requirement elaborates a performance characteristic of the system, non functional requirements of this project are:

Accessibility: the system is easily accessible

Availability: the system is available 24*7 and is accessible anytime

Recoverability: the system is easily recovered

Maintainability: the system is easy to be understood and maintain

Simplicity: the system has an easy to interact user interface

Efficiency: the system is very efficient

Robustness: the system is strong

CHAPTER 4

DESIGN

4.1 Design Goal

Design is a meaningful engineering representation of something that is to be build. It can be trace to a customer. Requirements and at the same time assessed for quality against a set of predefined criteria

For good design. In a software engineering context, design focuses on four major areas of concern: data, architecture, interfaces, and components the design process translate requirement into representation of software that can be accessed for a quality before code generation. Design is a process in which requirements are translated to blue print for constructing into software. Initially the blue print depicts the holistic view of software. This is a design represented at the high level of abstraction.

During various stages of system development and design of following goals have been set up for complete architecture

- Analysis
- Design
- Development
- Testing
- Deployment

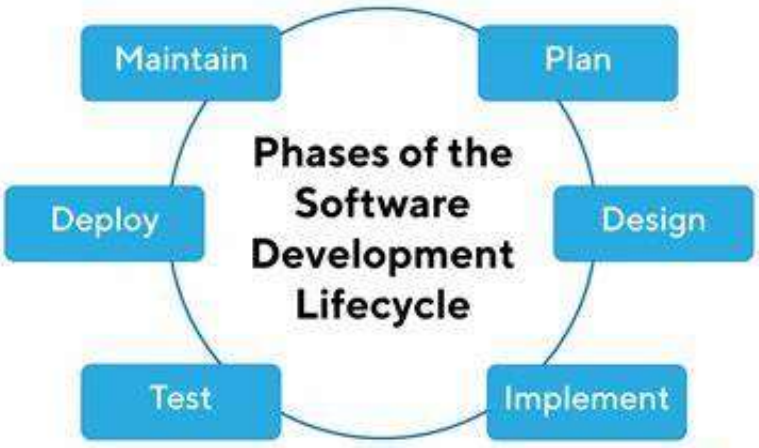


Fig. 4.1 Software Development Lifecycle

4.2 DESIGN STRATERGY

A good system design is to organize the program modules in such a way that are easy to develop and change. Structured design techniques help developers to deal with the size and complexity of programs.

System design is a critical component of software engineering and involves making decisions about the architecture, components, modules, interfaces, and data for a software system.

4.2.1 ABSTRACTION

An abstraction is a tool that enables a designer to consider a component at an abstract level without bothering about the internal details of the implementation. Abstraction can be used for existing element as well as the component being designed.

Abstraction is the process of filtering out - ignoring - the characteristics of problems that are not needed in order to concentrate on those that are needed. It is also the filtering out of specific details. From this, we can create an idea of what is to be solved.

4.2.2 MODULARITY

Modularity specifies to the division of software into separate modules which are differently named and addressed and are integrated later on in to obtain the completely functional software. It is the only property that allows a program to be intellectually manageable. Single large programs are difficult to understand and read due to a large number of reference variables, control paths, global variables, etc.

4.2.3 VERIFICATION

Verification is fundamental concept in software design. A design is verifiable if it can be demonstrated that design will result in implementation that satisfy the customers requirements. Verification is in two steps mainly

- Verification that the software requirements analysis satisfy the customers need
- Verification that the design satisfy requirements analysis

4.3 Parameters Considered for Designing PSAI:

- **Camera:** This is an input device comes as a part of almost all laptops and is an easily available add-on for desktop systems. The webcam is used to provide the proctoring authority (PO) with a live view of the user. This way the user can be monitored to ensure that they are attentively giving the examination, while simultaneously checking for any attempts at cheating. Using face recognition technology, the system can make sure that only the registered in user is giving the exam and this way prevent impersonation. The webcam can also be used to check for any other people in the background that try to help in cheating.
- **Mic:** This is again an input device that comes attached to most systems. The mic can be used to record audio and analyze it. The analysis can then be used to determine whether the user is being assisted by someone out of the field of camera view or via a call on another device. As background noises can also be considered as dishonest activities, the software needs to be trained to prevent false positives accordingly.
- **Human Proctor:** The systems in use today do not have a hundred percent accuracy rate. These require human oversight for dealing with false positives and to assist with grievance redressal this way the systems can be continuously trained to better the AI working in the backend. The PO will also analyze the report generated by the AIPS to render final judgment regarding the AIPS processes multiple inputs such as Audio and Video, and background application data. In case there is a false positive logged in any of these inputs, the PO can compare the inputs from all these sources to get a better idea before declaring it a copy case. There could be an instance where the AI might flag a calculator as a phone, and report the user as a "copy case" considering it to be a mobile device. In this case human oversight will be required to prevent a student from being wrongly accused.
- **Screen Share / Recording:** This way the user's screen is shared with the PO. The proctor can then view the tabs that are open on the student's screen to ensure that they do not open other web pages or notes to search for answers. This can also be recorded by the AIPS for future reference in case there is a

dispute on the flag raised by the system regarding suspicious activity. This also goes hand in hand with the Application Lock parameter, by recording the evidence of other applications being used to cheat.

- **Application Lock:** The application lock parameter is to ensure that no user access other programs in the background of the exam. The AIPS ensures that no other communication applications or documents are accessible during the duration of the test. This can be done via the "secure browser" method that does not allow tab switching. The user is also prevented from searching online for the answers via this method. Any attempts to do so will also be flagged as a copy case by the system. A simpler way to implement this concept is to use a regular browser and flag the user whenever they do make a tab.
- **Biometrics:** Using biometric verification, the system can verify that the user is not cheating via impersonation. It also adds another layer of security over a simple User ID and password combination that can be easily shared. This can also be used during the paper to make sure that the user does not switch places with someone during the paper. Facial recognition can also be implemented to act simultaneously throughout the duration of the examination.
- **Gaze Tracking:** Using gaze tracking, the student behavior can be monitored for copying using external resources like notes or textbooks. The student can be monitored using hardware add-ons like a gaze tracker. It can also be done by training the AIPS to identify when the user is looking away from the screen. The system must allow for small movements of the user, as it is not reasonable to assume, they will sit still for the entire duration of the paper.
- **Random Question Banks:** The paper can comprise of questions randomly selected form a pre-prepared question bank. In this manner the users will all get a paper unique to themselves. This method will also help nullify the attempts to copy by sharing the answers to a particular question as no two students would have a question bearing the same question number.

CHAPTER 5
METHODOLOGY

Online Examination Proctoring System Using Artificial Intelligence is machine learning based project which uses reinforcement learning for its working. Reinforcement Learning (RL) is the science of decision making. It is about learning the optimal behavior in an environment to obtain maximum reward. This optimal behavior is learned through interactions with the environment and observations of how it responds, similar to children exploring the world around them and learning the actions that help them achieve a goal.

In this work, we introduce RL-CNN, a framework based on Reinforcement Learning whose objective is to autonomously discover high performance CNN architectures for the given task without human intervention.

CNN model is developed to improve the accuracy of face image classification. The structure of the model is similar to the classical LeNet-5 model, but they are different on some parameters of the model, such as input data, network width and full connection layer. The developed CNN is composed of two convolutional layers (C1 and C2) and two pooling layers (S1 and S2). These layers are arranged alternately in the form of C1-S1-C2-S2 as sketched in Figure 5.1.

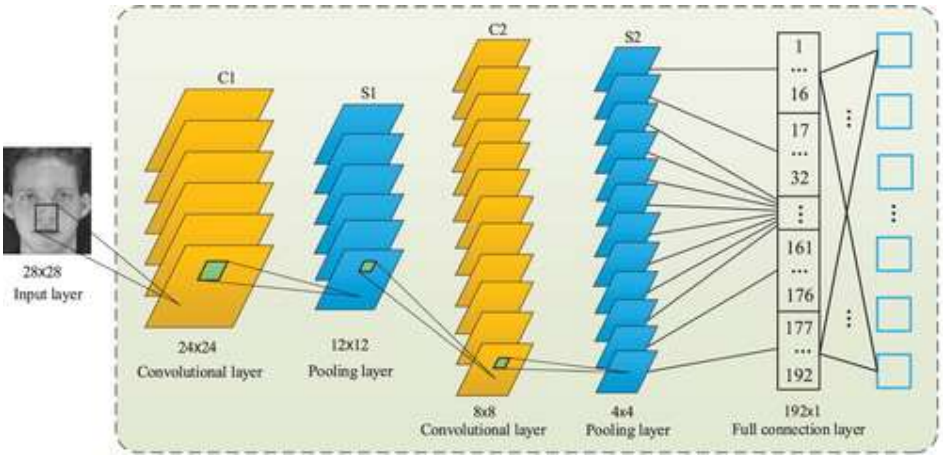


Figure 5.1. CNN model for face recognition

There is only one feature map in the input layer, which is used to put the normalized face image into the CNN model. C1 is the first convolutional layer that includes 6 feature maps, in which each neuron is convoluted with a randomly generated convolution kernel with size of 5×55×5. S1 is the first pooling layer, whose output is 6 feature maps calculated based on the output of previous layer. Each element in the feature map is connected with the mean convolution kernel of the corresponding

feature map in C1 layer, and the receptive fields of the elements will not overlapped with each other. C2 and S2 are, respectively, the second convolutional layer and pooling layer, both of which have 12 feature maps and similar calculation steps with their previous counterparts. Moreover, a fully connected single-layer perceptron is placed between the S2 layer and the output layer. As shown in Figure 6, the final output is a 40-dimensional vector for the face recognition of 40 individuals, where the *sigmoid* function is used for the multi-label classification.

5.1 Why CNN ?

1) CNN compares the image piece by piece. So CNN gets better seeing similarity than whole image matching schemes.

2) Since CNN is a kind of deep learning neural network, there is transfer learning happens, then it will learning more and also less error will occurred.

3) CNN can be thought of automatic feature extractors from the image.

4) CNN uses adjacent pixel information to effectively down sample the image first by convolution and then uses a prediction layer at the end.

5) CNN perform well feature extraction gives better accuracy.

6) CNN can work over multiple attributes simultaneously, make CNN a fast algorithm

WHY CNN IS BETTER THAN PCA?

An image and webcam is the visual representation of a thing or person created using optical technology (such as a mirror or lens) or a technological apparatus. 2 distinct domains of multiresolution image and web cam video fusion, i.e., PCA and CNN, are discussed in this study. Multiresolution image and web cam fusion techniques amalgamate more than two images covering optical unclear and blurred parts to produce an image covering all the focused areas or information. Based on the study, in both PCA and CNN. PCA is more straightforward among all image and web cam fusion approaches; meanwhile, according to the study conducted by International Journal Of Performance Engineering, it produces less effective results. On the other hand, CNN gives more effective results, but it is complex to handle. Also, the boundary pixels of the fused image and while using web cam has some mismatching problems, i.e.,unrecognizable pixels. The effectiveness of the results is measured based on some statistical image quality parameters.

Other Modules:

1. PCA for face recognition – Accuracy – 87%
2. ICA for face recognition – Accuracy – 89%

5.2 Work flow of model

Below is a brief summary of the suggested methodology. The online examination process is started first by the exam proctoring system. To begin the test, the student or test-taker logs into the system using their login and password. At student registration, the test-face taker's is already stored in the database. Facial recognition technology is used by the system to confirm each student's identification. If the student's face matches, they are allowed to take the exam; otherwise, they are not. When our proctored system begins functioning, if a student commits an error, the system warns them; however, if they receive more than four warnings, the student is removed from the exam.

After successful authentication student starts the exam, the following will cases might happen:

- if some kind of audio is detected by the system, system will show the warning error of “don’t speak”
- if someone else except verified student is found system will show the warning error of “multiple person detected” and user will log out of examination automatically.
- If during exam the if the verified student replace with non verified one, system will show the warning error of “you are not authorized user for the exam” and user will log out of examination automatically.
- If during exam user tries to open new tab, user will log out of examination automatically
- If user gives exam without cheating and successfully complete the process, student marks will get generated and visible over screen.

Role of admin/teacher :

- Add a student so the portal
- Add test/examination questions
- Make changes in question paper

- View marks of student
- Update students profile

Role of System :

- Cut /copy option is blocked for total time period of test taking
- The screen will be in full screen mode
- test time is over test will automatically gets submitted
- audio and video enable

5.3 FLOWCHART

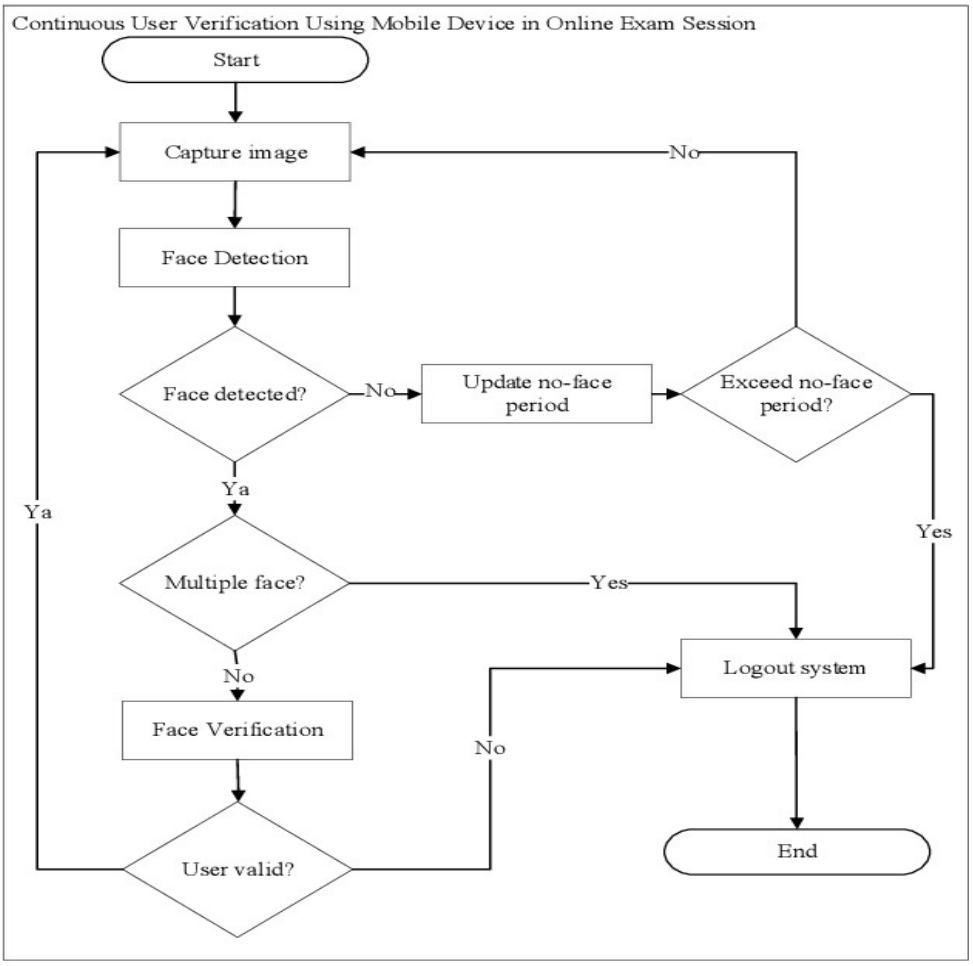


Fig 5.3.1 Flowchart

5.4. ALGORITHM

Convolutional neural network (CNN) is a kind of neural network with convolutional layers. In general, CNN contains two kinds of hidden layers, i.e. convolutional layers and pooling layers, which are usually arranged alternately in the neural network .

Similar to biological neural network, the connection weights of CNN can be shared in the whole neural network, which can not only reduce the amount of the connection weights, but also simplify the complexity of the network model. Thus, the training time of CNN can be remarkably shortened in most cases. In particular, when an image is the input of CNN, the image can be put into the neural network directly to avoid several complicated works, such as feature extraction and data reconstruction. Owing to the advantages of weight sharing, pooling and local receptive field, CNN has a robust performance on several image transformation operations, e.g. translation, rotation, and scaling. For the sake of completeness, the preliminary of CNN is briefly introduced in the rest of this section.

5.4.1. Activation function

The performance of a neural network is closely related to not only its structure but also the adopted activation function, which is usually selected as a nonlinear function to deal with some complex issues. Three frequently used activation functions in CNN are sigmoid, hyperbolic tangent (tanh) and rectifiedlinear unit (ReLU), which can be formulated as follows and illustrated in Figure 5.4.1.1.

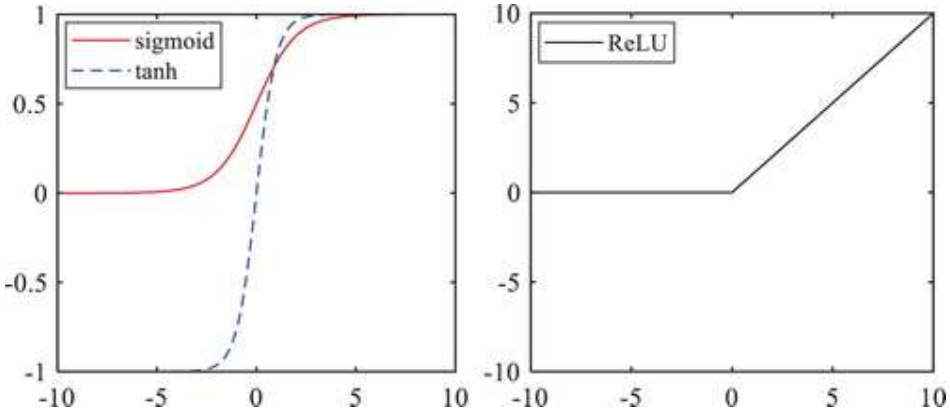


Figure 5.4.1.1 Activation functions.

5.4.2. Back propagation algorithm

Back propagation (BP) algorithm is one of the most frequently used algorithms to train a neural network, and the mapping of the input and output data is actually a nonlinear optimization problem of the connection weights. Based on the gradient descent (GD) of BP algorithm, the connection weights of neural network can be updated iteratively by minimizing the mean square error (MSE) between the real and expected values of the output. Here, the MSE, which is usually defined as the cost function in the training of neural network, can be expressed as:

$$E\left(\mathbf{W},\mathbf{B}\right) = \frac{1}{N_L}\sum_{i=1}^{N_L}\left(a_{iL} - t_{iL}\right)^2, \quad (4)$$

where $\mathbf{W}$ and $\mathbf{B}$ denote, respectively, the weight and bias matrices to be optimized in the neural network; a_{iL} and t_{iL} indicate, respectively, the real and expected output values of the *i*th neuron in the output layer with N_L neurons.

In the neural network shown in Figure 2, the output of the *i*th neuron in the *l*th layer can be calculated as follows:

$$a_{il} = f_{il}\left(\sum_{j=1}^{N_{l-1}} w_{ijl}a_{j,l-1} + b_{il}\right), \quad (5)$$

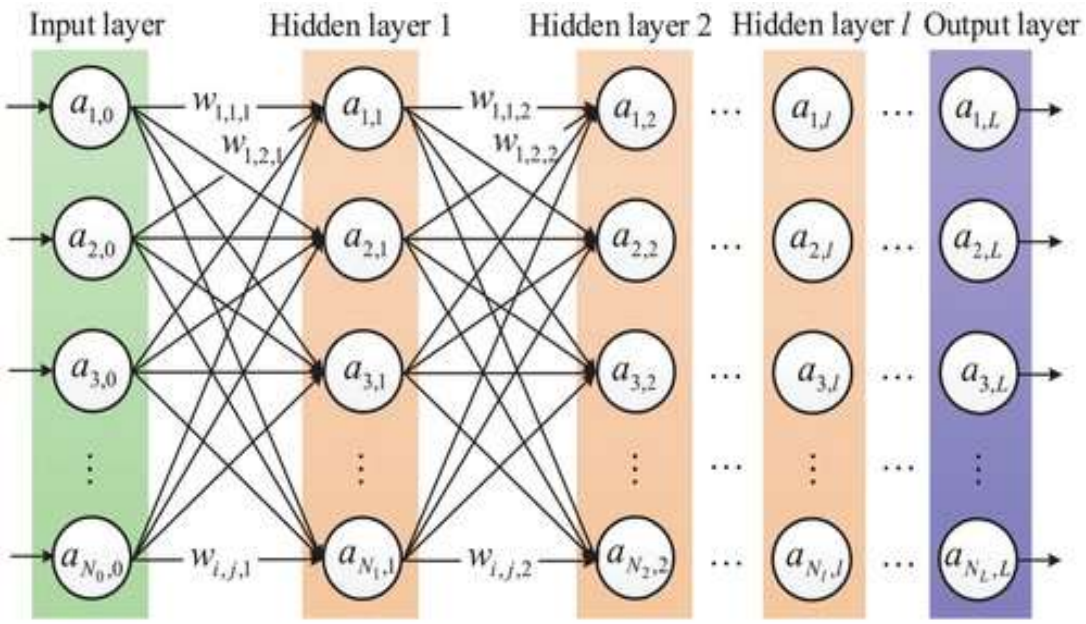


Figure 5.4.2.1: Structure of neural network.

5.4.3. Convolution Layer Operation

Convolution is a kind of mathematical operation that has been widely used in image processing. The result of convolution can be sorted as three modes, i.e. the modes of Full, Same and Valid, which can be utilized in different occasions. For example, Valid mode is usually applied for forward propagation to facilitate the feature extraction of image, and Full mode is often employed in the back propagation to obtain the optimal weights.

In the convolution operation, the operation of edge zeroing is implemented for the input image, where the layer amount of the edge can be determined according to the size of the convolution kernel. The purpose of edge zeroing is to ensure the rationality of the results, i.e. the elements of the input image and the convolution kernel can be weighted and summated sequentially. Additionally, the convolution kernel should be turned around and flipped up and down as shown in Figure 3, where the kernel is actually rotated 180 degrees around the centre.

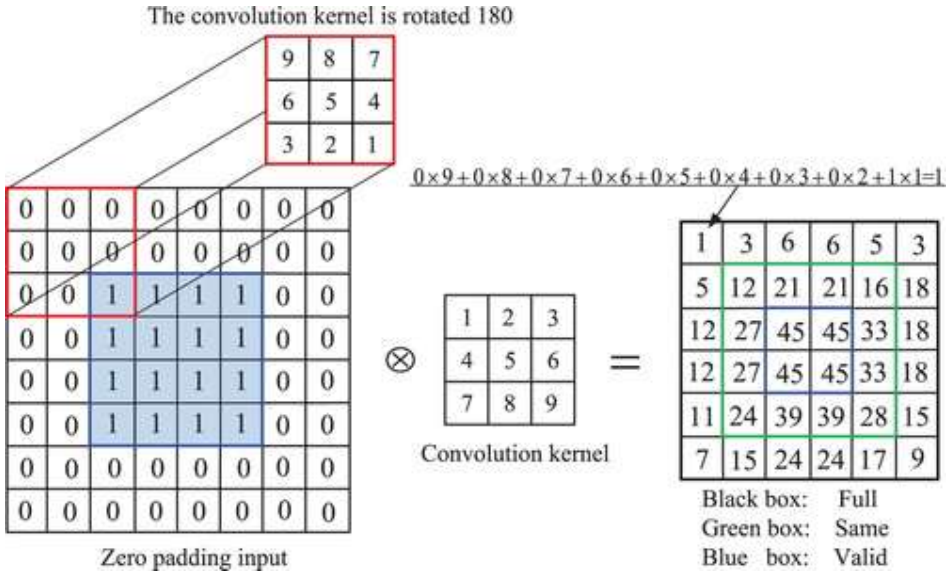


Figure 5.4.3.1 Convolution operation.

Display Full Size:

It is worth noting that convolution operation can achieve sparse multiplication and parameter sharing, which can compress the dimension of the input data. In

comparison with DNN, it is not necessary for CNN to provide connection weights separately for all neurons of the input data. Actually, CNN can be regarded as a common feature extraction process like most neural networks used for feature extraction.

5.4.4. Receptive field

The local connection field of a buried layer neuron serves as the receptive field in CNN. Suppose that the input of the neural network is an image with 100×100100×100pixels and there are 100 neurons in the hidden layer, there will be 100×100×100100×100×100connection weights between the input and the hidden layers if every pixels of the image are connected to all neurons of the hidden layer as shown in Figure 3.2.4. There is no doubt that the huge computation load will decrease the training efficiency of the neural network. In contrast, if each hidden neuron is connected to a local field of the input image(e.g. 10×1010×10 pixels) , the amount of connection weights will be reduced to 10×10×10010×10×100, which is 1/100 of the full connection case.

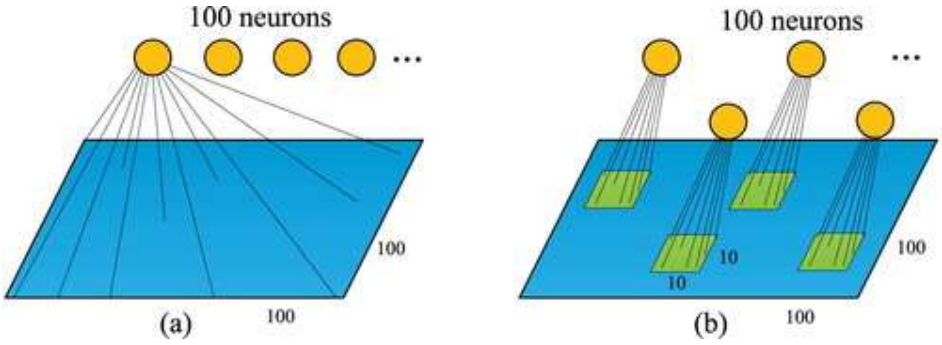


Figure 5.4.4.1 Receptive field

In actuality, the shared weight method—in which each neuron in a convolution kernel has the same weight—can further lower the connection weights. This allows for a reduction in the number of connection weights from 10×10×10010×10×100 to 10×1010×10. As a result, the neural network's training pace can also be greatly accelerated.

5.5.5. Pooling

The pooling layers, which are usually located behind the convolutional layers, are mainly used to compress the output feature data of the convolutional layers. After the pooling layer, the improved output results can reduce the likelihood of over-fitting in the neural network. Besides, the feature of image can be further extracted through pooling operation without influencing on the information acquisition of the image.

Actually, pooling is a reduction processing of the image, which can be classified as mean-pooling, max-pooling, overlapping-pooling, stochastic-pooling, and global average pooling. For instance, mean-pooling can extract the average value of the feature points and has the effect of maintaining the relative background; while max-pooling can extract the maximum value of the feature points and achieve better texture extraction. Specifically, for the mean-pooling, if a feature map with size of 4×44×4 is sampled by using a kernel with size of 2×22×2, the output is a feature map with size of 2×22×2 as shown in Figure 5.

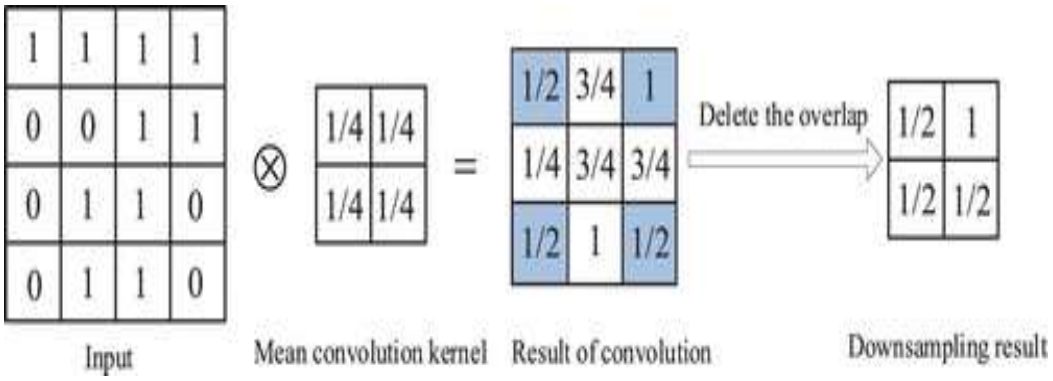


Fig. 5.5.5.1. Pooling operation.

CHAPTER 6
IMPLEMENTATION

The working of proposed methodology for Online Examination Proctoring System using Artificial Intelligence will work according to the following steps:

6.1IMPLEMENTAION STATERGY:

It is a reinforcement model implemented using CNN. The reinforcement model is trained not on preset data but rather based on a feedback system.

Step 1: Upload a image of the student taking the test.

Step 2: Resize the image

Step 3: Importing the required libraries

Step 4: feature extraction and Classification

Step 5: Once the features have been extracted, the model begins to function and continually compares the image's features to the students who are actually taking the test.

Step 6: It will display a warning if any malpractice is discovered.

Step 7: The system will automatically log out if the number of warnings reaches 5.

6.2 HARDWARE PLATFORM USED:

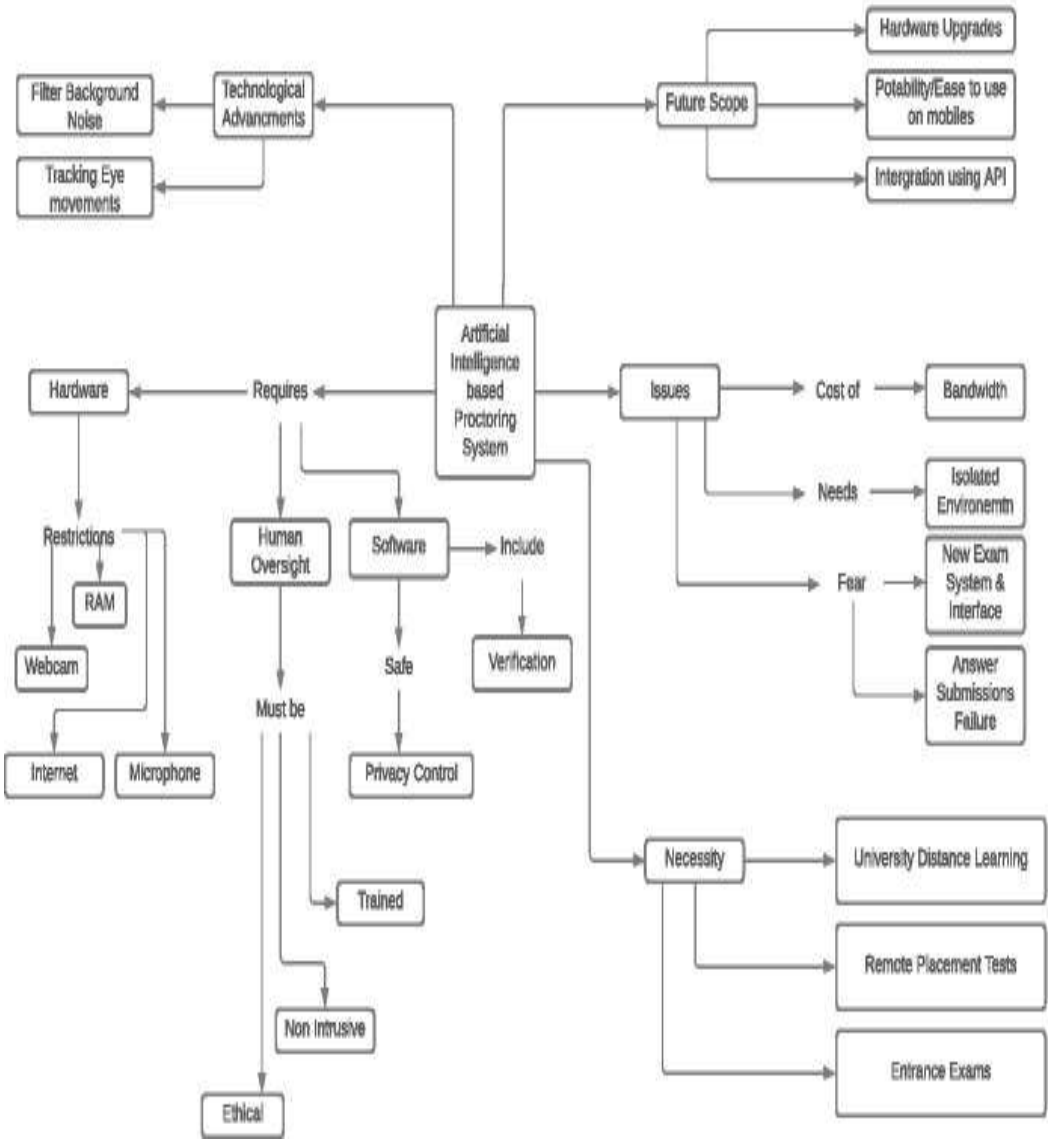
- Intel i5 Processor or above
- 4GB RAM
- Monitor , Mouse, Keyboard, Web Camera

6.3 SOFTWARE PLATFORM USED:

- Windows 10 operating System
- Google Chrome Updated Browser
- VS code editor
- JavaScript libraries
- HTML, CSS , BOOTSTRAP
- MYSQL, Python, Django

6.4 Features Online Proctoring System:

Features	Description	Newer Technologies
Authentication	Authentication includes verifying the identity of both candidate and proctors who are the part of proctoring software	Two factor authentication, OTP, Face recognition is used to authenticate entity in proctoring system
Browsing tolerance	This is restriction provided by proctoring system software about usage of other resources (such as other tabs of browsers, other face detection during live proctoring etc.)	This is done by log tracking and analysis, Face detection, Object Detection etc
Remote authorizing and control	It gives authority to the proctor to take control over proctoring system (like he/she can start/pause/stop the examination of a particular student remotely)	This is generally done by giving administrative rights and using multilevel security models
Report generation	It is about creating the student's report and activity log during the exam	This is normally done by the technologies like Python, ASP.net or any other open-source programming language



6.1 Concept map of AIPS

CHAPTER 7
OUTPUT

ADMIN/TEACHER VIEW:

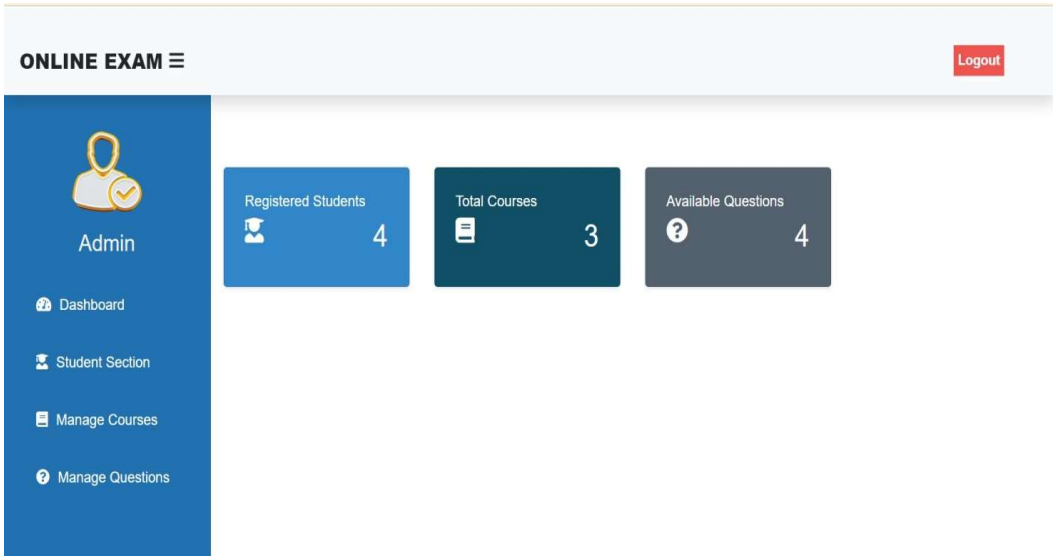


Fig. 7.1 Home Page

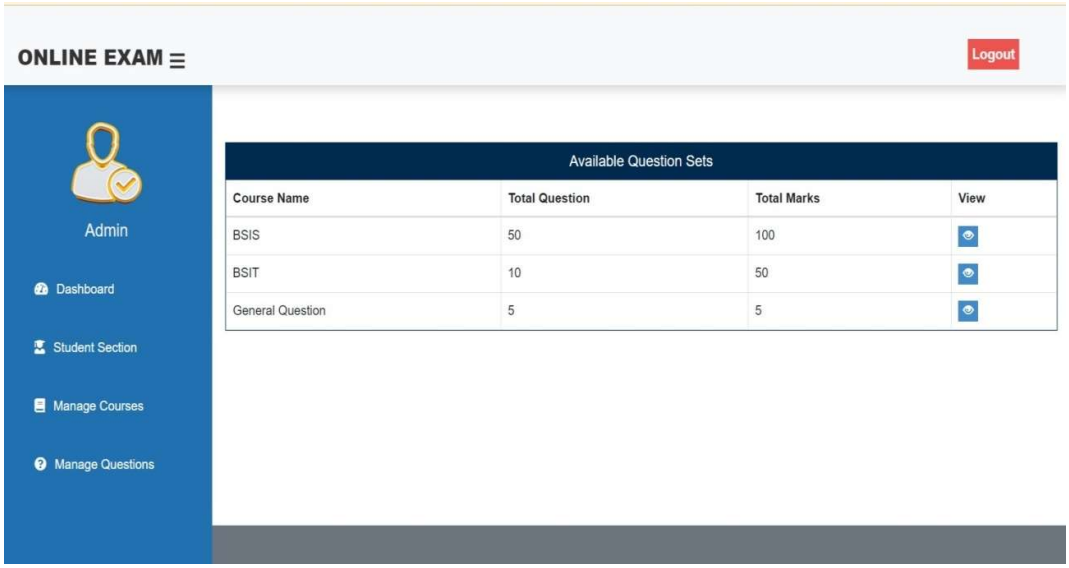


Fig. 7.2 Manage Question Section

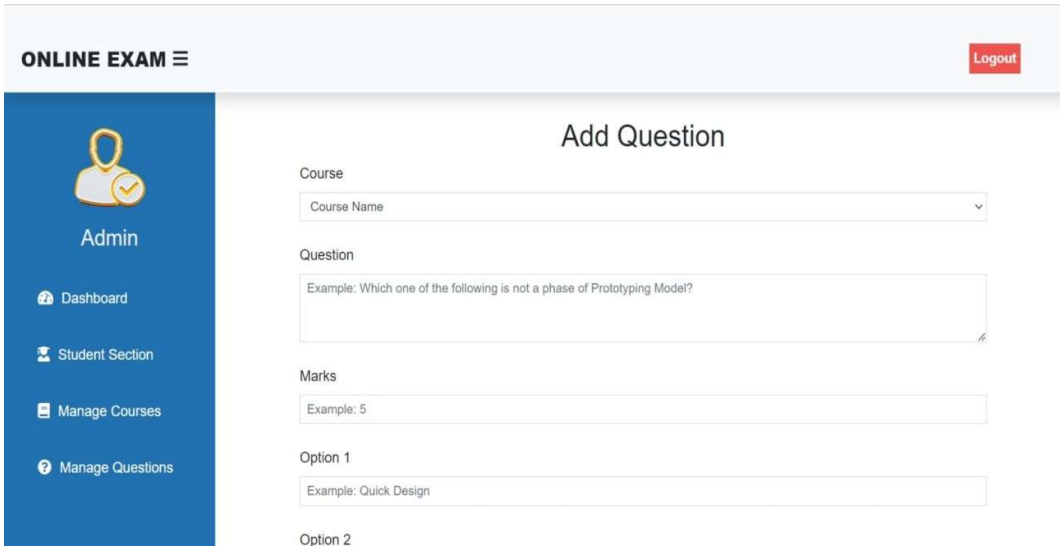


Fig. 7.3 Course section

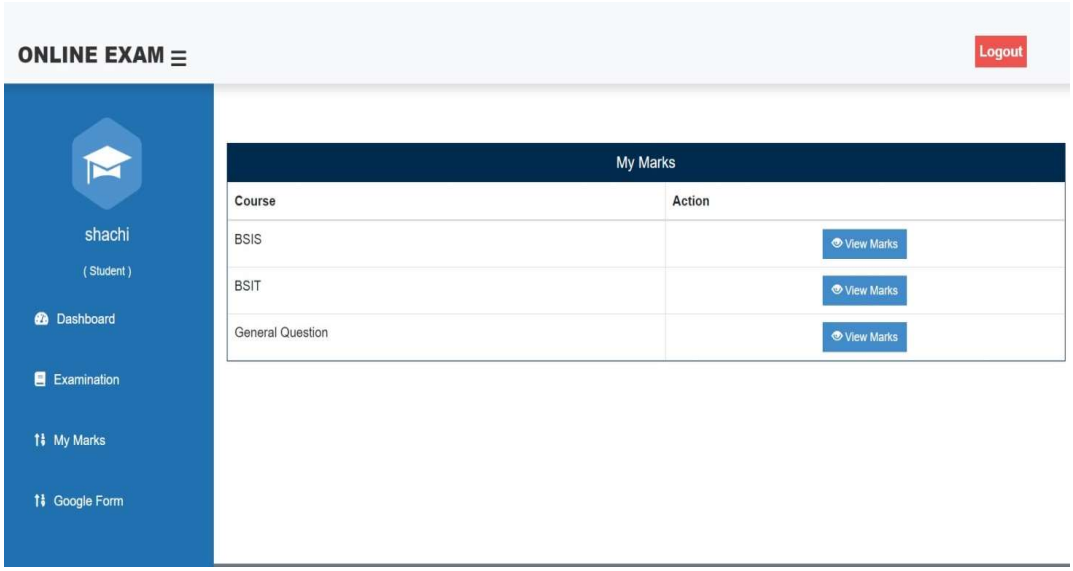


Fig. 7.4 Editing of marks and papers

STUDENT VIEW:

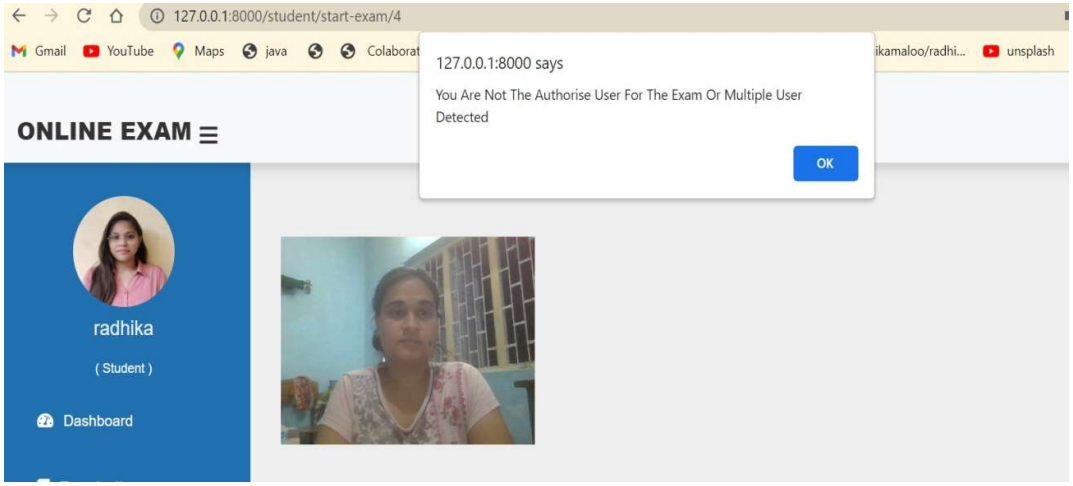


Fig. 7.5 Authorize users warning

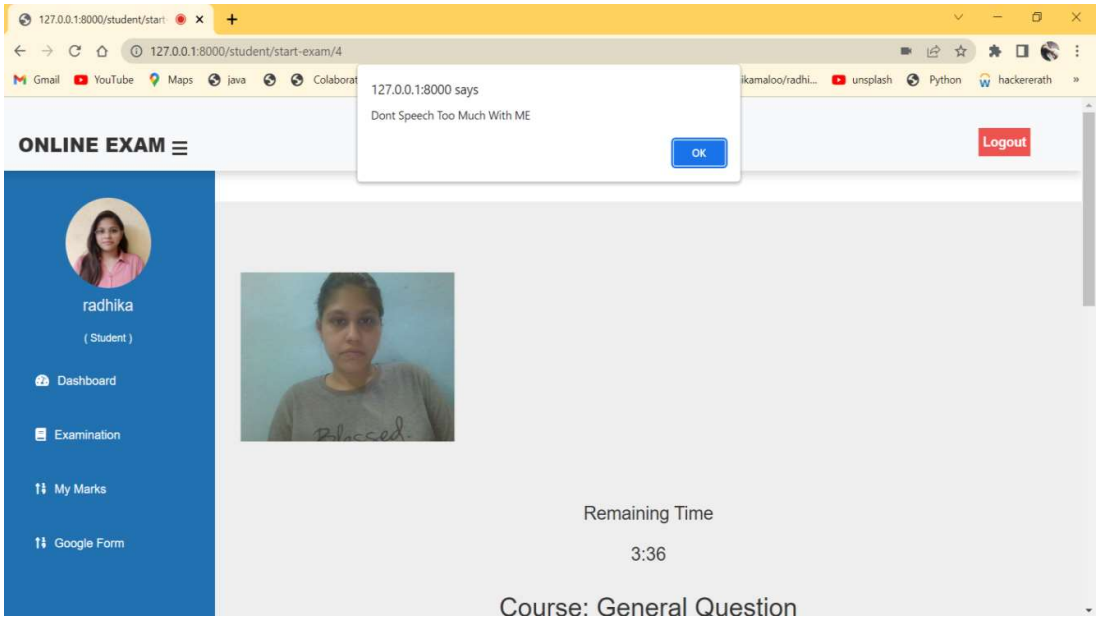


Fig. 7.6 Audio Warning

CHAPTER 8
CONCLUSION

Systems for proctoring online tests have the potential to completely change how exams are given and tracked. The system can validate the identity of the test-taker and track their behaviour during the examination with the use of artificial intelligence. It can also identify and prevent cheating. In addition to ensuring that the results correctly represent the test-takers' skills and understanding, this can improve the exam's reputation and integrity. The privacy, fairness, and reliability issues with AI-based proctoring systems must be addressed, though.

Online testing is the next wave of adoption after online learning which has seen a significant rise in demand due to the problems posed by the ongoing COVID-19 Pandemic. OPS do not claim to be completely fool proof but are rapidly changing the adoption of online testing from home, a scenario that previously would have been thought to be preposterous amongst the masses.

This paper is denouement to our base paper [1]"Automated Online Exam Proctoring System" which presents a multimedia analytics system for online exam proctoring, which aims to maintain academic integrity in e-learning. The system is affordable and convenient to use from the text taker’s perspective, since it only requires having two inexpensive cameras and a microphone. With the

captured videos and audio, we extract low-level features from five basic components: user verification, text detection, speech detection, gaze estimation, and phone detection. These features are then processed in a temporal window to acquire high-level features, and then are used for cheat detection.

To sum up, it is difficult to know whether the benefits of these Online Proctoring technologies outweigh their risks. The most reasonable conclusion we can reach in the present is that the ethical justification of these technologies and their various capabilities requires us to rigorously ensure that a balance is struck between the concerns with the possible benefits to the best of our abilities.

CHAPTER 9

Future Scope

Educational institutions and corporate organizations across the world had gradually begun the process of adopting online proctoring software over the past decade to conduct remote examinations in a fair manner and ensuring that the candidates gave the exam in a known environment. Due to the COVID-19 Pandemic, it has become the need of the hour to leverage remote proctoring platforms to conduct seamless tests while also ensuring that the candidates do not indulge in malpractices during these online exams.

There are numerous benefits to any organization when they conduct any assessment via remote proctoring instead of the traditional pen-and-paper based method. Scheduling exams becomes easier as there is no need to set up specific testing centers to conduct examinations. Communication between the examiner and the examinee is more streamlined, hassle-free and faster. Results of the examination can be generated faster and, in some cases, almost instantly. Online examinations also give the organization the liberty to conduct the exam on a massive scale without worrying about maxing out the capacity of the examination centers.

However, a sincere effort needs to be made for developing proctoring technologies to ensure that the level of online examinations is at par with offline examinations in all aspects; be it integrity of marks scored, ensuring candidates do not get involved in wrongdoings etc. Social perception of the masses towards online exams also needs to be changed and they must be made aware of the benefits for the same. The issues while designing an AI-based proctoring system as discussed by above need to be tackled with the use of existing technologies. Advancement of technologies will no doubt be beneficial for constructing more robust and secure systems but currently, anticipating the growing need for these software; a conscious effort needs to be made to enable existing technologies in mitigating the issues that exist.

This mode of authentication is more readily available in today's world but it still is not 100% foolproof in determining the identity of the candidate. A more secure method of biometric authentication would be using iris scanning as a tool. However, the hardware capabilities for the above method are not commercially available in devices and hence, candidates will have to spend money to get the required hardware components. Any attempt at forcing a person to buy something specifically for using a

remote proctoring software would defeat the efforts made to achieve global acceptance of the technology. Hence, continued human proctoring throughout the exam duration is a “necessary evil” which needs to be employed while designing a proctoring software.

One of the primary approaches that should be taken for authenticating the test-taker’s identity, is multi-factor authentication. With biometrics on the rise, devices such as mobile phones, tablets and laptops are now incorporating fingerprint scanners and face scanners. Mass production of such devices results in everyone using at least one biometric service available. While password can serve as the first module, OTP-based verification, facial recognition, and fingerprint authentication can be used at the second stage of any OPS. While a few AIPS have also made use of iris tracking among several other techniques, one must understand that these require high-end hardware that isn’t available or affordable for everyone.

Online education and online examinations are two sides of the same coin, and bridging the gap between these is very important. Several software aims to analyze students’ behaviors in online classes and obtain their unique behavioral characteristics, and then provide this information to proctoring services for better invigilation in online exams. Many such software will be introduced in the future that would aim to help strengthen the numerous pillars of online education.

In the years to come, this revolutionary change that has been brought upon us by the Pandemic will not diminish. If anything, it has only reinforced the idea that online education is not only possible, but also highly effective and practical. More and more institutions are offering distance-learning courses and complete degrees that one can get by studying in the comfort of their homes. In such cases, AIPS are here to stay, and will only make more leaps in the future.

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RESEARCH PAPER

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Online Examination Proctoring System Using Artificial Intelligence

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Abstract*—The scalability of the next level of education is significantly constrained by the capacity to effectively proctor distant online exams. The most popular method of evaluation at the moment is human proctoring, which involves either requiring test-takers to go to a testing facility or watching them on a webcam visually and audibly while they complete the exam. Monitoring student attendance is crucial in online learning because student presence contributes to effective teaching and learning assessments. However, these techniques are expensive and labor-intensive. Additionally, there is a growing movement towards Online Courses, which allow students to enrol in courses that will broaden their knowledge and creative potential. *Instead of traditional classroom teaching a student can take a course from anywhere in the world using a computer. The certificates for Online Courses should be provided after the student gives a proctored examination. Hence some kind of online portals are needed for a trustworthy proctoring of online examination Our portal will help in automating the proctoring the online examinations. This portal will track the exam givers – eye ball movement, lip movement, audio tracking, phone detection, person counting.

Keywords—Proctoring System, Convolutional Neural Network(CNN), Online Examination System, Remote Proctoring

I. Introduction

Any program of studies must have exams, and online learning programmes are no different. Every exam has a tendency for cheating, hence its recognition and avoidance are crucial. For educational qualifications to remain valuable to the community, they must demonstrate true learning..To protect the integrity of the assessment process, traditional exams and tests must still be taken in supervised settings, within designated exam hall, with physical examiner present. As a result, both the institution and the candidate are forced to choose an expensive model. While some students may find this to be less of an issue because they are physically present in class, an increasing portion of the industry is focused on the remote offering of every course. In many cases, even if their professors may be thousands of miles away, students still must make their way to testing facilities to take their tests.

In accordance to a report by UNESCO Instructional Distortion and Reaction to the pandemic of COVID-19, a large number of governing bodies globally are shutting down educational organisations and considerably moving their activities to online and mobile modality, which will effect more than 89% of the global population of students.The models that are used for proctoring are still very important, as is the level of evaluation done to stop mistakes in remote settings. This study contains high-level similarities of flagging, removing, and detecting anomalous activity in addition to strengthening false positives till notable accuracy is attained. While this kind of system supports the use of numerous recognition processes, including those for facial detection, Sound detection, Eyeball movements recognition, Change of tabs detection, Device finding, and others, it is frequently the case that any or all of these mechanisms, when combined, can improve the equality of an investigation, give it greater trust and honesty, and assist in avoiding not being repudiated.

What does Remote Proctoring mean?

This refers to the procedure utilised to proctor, or watch over, applicants while they take an online test. Those who are in charge of this process can monitor the applicants from anywhere in the world thanks to technologies.

This procedure is meant to deter candidates from using fraud or other unethical tactics when taking an online exam.Remote proctoring is one of the methods that might be utilised to prevent cheating or any other malpractice when giving assessments online.

Fig.1. Online Proctoring System

II. Literature survey

There is an additional proctoring check in [1] by Yousef Atoum that uses a mechanism for analysing multimedia content that speech, phone, and gaze detection. To make gaze recognition easier, wear cam has also been utilised in conjunction with webcam. The employment of a webcam and a gaze cam in sync allows for a real-time checking what the user sees twice. As a consequence of eliminating incorrect results and instances of cheating that have been proven, the cheat recognition mechanism in this situation integrates a number of variables and flags used by the user in the event of entropy across multiple utilised processes, such as sound detection, missing legitimate gaze detection, and various other characteristics. Using a binary SVM classifier, the audio wavelength is divided into 16 separate pathways, and voice is considered an optimistic sample.

The Face Settlement problem for a single image in [2] by Vahid Kazemi and Josephine Sullivan is the main topic of the theory. It shows how an ensemble of trees of regression can be utilised to execute with great projections to determine the facial milestone positions or milestones from a poor portion of pixel powers. They offer a basic framework for learning a set of relapse trees based on inclination boosting that minimises square damages and efficiently manages lost or ambiguous data. They use visual data to show how applying fitting priors facilitates making wise component decisions.

A practical concept for enabling mobile and digital proctoring while student examination is presented in the paper [3] by N.L. Clarke and P. Dowland. Throughout the course of the exam, the approach employs transparency identification to give a constant, unobtrusive identification of the student's existence. An examination of the platform's innovation is used to create a model, which shows how successful this strategy is.

A novel strategy is used in [6] by AsepHadian S. G and Yoanes Bandung, in which user identification is given significant priority on a constant scale. The CNNs are trained to recognise the user in situations with low light and in general using a big collection of user photos. By using classifiers that highlight characteristics that have to undergo not linear mapping, the CNN has been able to learn the values. The system accuracy rate is determined at the last assessment stage using the false acceptance rate and false rejection rate from the confirmation procedure.

The focus of [7] by Aiman Kiun is on the use of Convolutional Neural Networks for identifying fraudulent activity in video clips of exams. The image filtering employed models depended upon utilisation of Rectified activation units , which in turn displayed outstanding outcomes for large scale data sets. A user interface, video manipulation, and image categorization made up their framework.Unavoidably, the interface will upload the students' exam-taking video into a pipeline that includes a number of steps. The enormous recorded would be condensed into a small number of minimalism images, and several duplicate or similar-looking frames would be deleted since the applicant images were already included in the examining collection. This would lessen the workload of the proctoring setup.

III. Methodology

This part contains the methodology, which explains how the study was conducted in order to perform comparative analysis. The objective of this effort is to develop an electronic multimedia assessment system that can spot various forms of exam-taking fraud..Our recommended online exam method consists of two steps: the preparatory phase and the actual test phase. Before beginning the exam, the test-taker must verify himself using a password and face recognition during the preparatory stage. To make sure that all of the sensors are connected and operating correctly, this phase also includes calibration procedures.Also, the test taker is taught and verbally agrees to the Online Exam Proctoringsystem's regulations, which include things like not letting anybody else use the room while the exam is still in progress.The person taking the test completes the assessment during the examination phase while being continuously "monitored" by our online examination proctoring system, which allows in the identification of fraudulent activity in immediately.

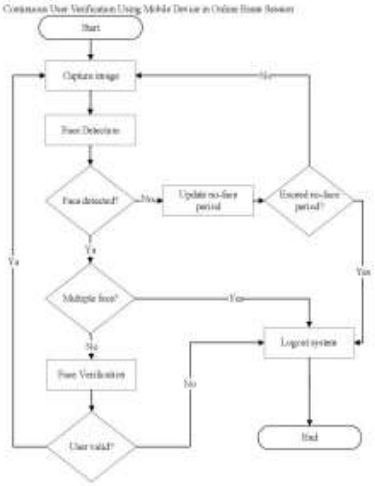

Fig. 2. Flowchart for Proposed Methodology

A. Flow Chart of Proposed Methodology

Below is a brief summary of the suggested methodology. The online examination process is started first by the exam proctoring system. To begin the test, the student or test-taker logs into the system using their login and password. At student registration, the test-face taker's is already stored in the database. Facial recognition technology is used by the system to confirm each student's identification. If the student's face matches, they are allowed to take the exam; otherwise, they are not. When our proctored system begins

functioning, if a student commits an error, the system warns them; however, if they receive more than four warnings, the student is removed from the exam..

B. Algorithm

A type of neural network having convolutional layers is a convolutional neural network. Convolutional layers and pooling layers are the two main types of hidden layers found in CNNs, and they are typically stacked alternately in neural networks. In a manner similar to neural networks in biological systems, convolutional neural network capacity to spread connection weights over the whole neural network not only enables a reduction of link costs on the whole, but also lessens the complexity of the network model. As a result, convolutional neural network training period can typically be drastically reduced. In particular, a picture can be simply fed into a CNN rather than having to go through the laborious processes of feature extraction and data reconstruction.

1) Activation Function:The effectiveness of a neural network is also closely correlated with the accepted activation function, that is often selected as a nonlinear function in order to handle some complicated situations. Three frequently utilised activation functions in CNN are the sigmoid, hyperbolic tangent (tanh), and rectified linear units (ReLU), and they may be described as follows.

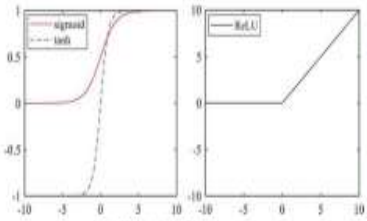

Fig. 3. Activation Functions

2) Back Propagation Algorithm: The back propagation (BP) method is one of the many widely used techniques for training neural networks. A nonlinear optimising problem of linking values underlies the transformation of both the input and the output data. The gradient descent of BP technique may be used to iteratively modify the weights for connection of a neural network by lowering the mean square error in the actual and predicted values of the output.

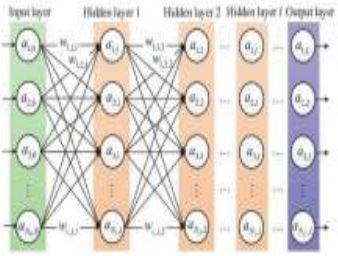

Fig. 4. Structure of Neural Network

3) Convolution Operation: In image processing is a type of computation operation that is frequently applied. Three modes—Full, Same, and Valid—that can be used in various contexts—can be created from the convolutional result. For instance, Valid mode is typically utilised in forward propagation to facilitate the extraction of image features, while Full mode is usually utilised in back propagation algorithm to obtain the optimal values. The quantity of the edge layer is determined by the measurement of the convolution kernel in the convolution process known as "edge zeroing," which is applied to the input picture. Edge zeroing is used to ensure that the results are logical, meaning that the convolution kernel and the image's input components may be gradually weighted and combined. As shown in Fig. 5, the convolution kernel's shape should be flipped up and down while it is really rotating around 180 degrees about the centre.

It's crucial to remember that convolutional processes have the ability to do sparse multiplication and parameter sharing, that can minimise the dimension of the input data. CNN doesn't require the link values be given separately for every neuron in its input data, in contrast to DNN. In fact, because it is a widely used extraction of features method, CNN is equivalent to the majority of neural networks used for feature extraction.

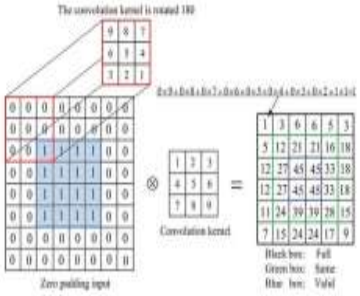

Fig. 5. Convolution Operation

4) Pooling: The pooling layers, that are frequently positioned after the convolutional layers, are largely used to compress the resultant information regarding features that

*results from the convolutional layers. The pooling layer's superior outputs can reduce the likelihood of excessive fitting in the neural network's model.*Moreover, a pooling technique can be used to further extract an image's feature without affecting how the image's information was acquired.

Additionally, there are several forms of pooling, including mean pooling, maximum pooling, overlapping pooling, stochastic pooling, and global average pooling. In essence, pooling is a minimised procedure of the picture. Mean-pooling may obtain the median amount of the points of feature with the effect of keeping a comparable background, in opposition to max-pooling, which could capture the highest possible number of the characteristic points and provide greater textured extraction. The output of the mean-pooling is a characteristic mapped with a value of 2×22×2 when a characteristic mapped had a value of 4×44×4is obtained by sampling using a kernel that corresponds to that size.

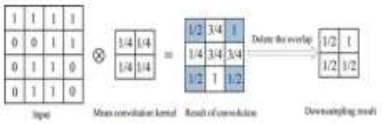

Fig.6. Pooling Operation

IV. Conclusion and Discussions

Systems for proctoring online tests have the potential to completely change how exams are given and tracked. The system can validate the identity of the test-taker and track their behaviour during the examination with the use of artificial intelligence. It can also identify and prevent cheating. In addition to ensuring that the results correctly represent the test-takers' skills and understanding, this can improve the exam's reputation and integrity. The privacy, fairness, and reliability issues with AI-based proctoring systems must be addressed, though.

AI-based online exam proctoring solutions have grown in acceptance in the past few years as remote education and online assessments become more prevalent. These systems watch the test subjects and look for any unusual behaviour using a number of AI technologies, including facial recognition, voice recognition, eye tracking, and keystroke analysis. Speedy evaluation, decreased cheating, and increased test security are all advantages of AI-based proctoring systems.

The impartiality, dependability, and privacy of these systems, nevertheless, are also issues. For instance, because of technological problems like a slow internet connection or mismatched technology, certain learners may receive unjust punishment. The correctness of the AI algorithms, which may be biassed or prone to mistakes, might also have an impact on the dependability of Intelligence-based proctoring systems.

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