Proctored Online Examination System with Anti Cheat

A Project report submitted in

partial fulfillment of the requirements

for the Degree of

Bachelor of Technology

in

Computer Engineering

Submitted by

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DEPARTMENT OF COMPUTER ENGINEERING

CERTIFICATE

This is to certify that the Project entitled "Project Title" has been carried out by

Dhanashri Randive

Dipashri Deshmukh

Pushkar Asapure

Sarvesh Chaudhari

under my guidance in partial fulfillment of the degree of Bachelor of Technology in Computer Engineering of Dr. Babasaheb Ambedkar Technological University, Lonere during the academic year 2020-2021. To the best of my knowledge and belief this work has not been submitted elsewhere for the award of any other degree.

Date:

Place: Dhule

Guide

Prof. B. R. Mandre

Head   **Principal**

Prof. B.R. Mandre   Dr. Hitendra D. Patil

ACKNOWLEDGEMENT

ABBREVIATIONS/NOTATIONS/NOMENCLATURE

Abbreviation/Notation/Nomenclature	Details
AI	Artificial Intelligence
WSGI	Web Server Gateway Interface
NLP	Natural language Processing
ES	ECMAScript
ML	Machine Learning

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ABSTRACT

All industries have been affected by the COVID-19 pandemic and everyone has worked to develop alternative strategies and actions to survive and continue business operations, the education sector is no exception. School, University examinations, and hiring processes have faced challenges in finding the appropriate mechanisms to manage the examination process and prevent cheating online. The ability to efficiently proctor remote online examinations is an important limiting factor to the scalability of this next stage in education and career. Presently, human proctoring is the most common approach of evaluation, by either requiring the test taker to visit an examination center or by monitoring them visually and acoustically during exams via a webcam. The purpose of the online test simulator is to take an online test in an efficient manner and not waste time checking the paper. The main objective of an online proctor test simulator is to efficiently evaluate the candidate thoroughly through a fully automated system that not only saves a lot of time but also gives fast results. For students, they give papers according to their convenience and time and there is no need for using extra resources like paper, pen, etc. It fulfills the requirements of the institutes to conduct the exam online. Students can give exams without the need of going to any physical destination. They can view the result at the same time. Thus the purpose of the software is to provide a system that saves the efforts and time of faculty.

Key Words: online, exams, remote proctoring, artificial intelligence

INTRODUCTION

1.1 BACKGROUND

The existing system of conducting examination processes is manual. It is a large manpower process and difficult to implement at different platforms. It has so many problems. In the traditional exam process, an invigilator has to be present at the exam center to check candidates appearing for the exam. To examine 30-40 candidates, you require one invigilator. However, to conduct an exam of 1000+ candidates, you would need more than 25 invigilators controlling the exam process. This is not possible in the current scenario.

1.2 MOTIVATION

Covid-19 a global pandemic has prompted teachers to adapt and find new methods of online assessment since traditional assessment methods are not feasible in the current scenario. Remote Proctored examinations can easily reduce the burden by keeping students who have access to computers and the internet at home and the rest could write the exams conventionally. Online Proctoring examination is emerging as a possible solution to address the concerns around social distancing. Online examinations are considered an important source for university exams. Moreover, the development of network technologies has given the possibility to deliver the exams online. Thus, education can benefit from these services.

1.3 PROBLEM DEFINITION

To do away with the manual method of paper and pen for the online examination has posed a serious threat to the standard of student ability during exams. The manual method could not handle the problem of sorting, the problem of online examination, and tutor-marked exam malpractice during exams as result an efficient method has to be put in place to eradicate the possibility of occurrence in the system. An online examination system helps to reduce the fears of students thinking they were marked down during the manual exams.

To save the cost of constant purchase of answer booklets and also save time and human labor of strolling round the exams to checking for student irregular act in the exam hall, malpractices etc.

1.4 SOLUTION

Remote proctoring is the process of authenticating, authorizing and controlling the online examination process in a scalable manner. It is a technology that allows organizations to enable assessment anywhere and anytime, ensuring full security standards. Online proctoring can be conducted through the internet via the web camera of the candidate. It can record every single examination session from beginning to end, not just via video, but also captures audio, desktop screens, chat logs and images.

1.5 OBJECTIVES AND SCOPE

The objective of an online test simulator is to take online tests in an efficient manner and no time checking the paper. The main objective of an online test simulator is to efficiently evaluate the candidate thoroughly through a fully automated system that not only saves a lot of time but also gives fast results. For students they give papers according to their convenience and time and there is no need of using extra things like paper, pen etc. Corporate between the data stored in the server of the Institution and our online examination system. To deal with the Online Exams in an easy way and an efficient manner. (Connection process) Create a strong and secret database that allows for any connection in a secret way, to prevent any outside or inside attacks or question leakage. Specify a privilege to administrators to be able to change their question at will before the online examination system. Prevention of exam malpractices by applying strict timing possibility for each question and marking of questions immediately. The student fear of being marked down is eradicated and sorting practice is reduced.

Chapter 2
LITERATURE SURVEY

When training processes are carried out in remote places, the presence of students and teachers or examiners who certify their knowledge becomes a problem. In this context, trying to avoid this presence, most of the evolutions and changes have occurred in the teaching-learning processes, leaving the evaluation system relegated to physical presence in a specific place, for reasons of supervision. However, a point has been reached where the educational system and society demand tools that seek to ensure the quality of the evaluation process without necessarily requiring physical presence in a specific place. This demand has led to the emergence of tools that allow monitoring this remote evaluation system through telematics resources, achieving e-proctoring in online teaching. The e-proctoring is being used regularly in MOOCs, where online courses tried to impose themselves as substitute products for traditional teaching but found their main problem in the supervision of their evaluative tests for the subsequent certification of the knowledge achieved. As of today (since 2017), platforms such as edX (one of the main platforms in MOOCs) already use this methodology.

This proctoring method allows:

Visual and auditory surveillance, using the audio and cameras of the examinee's computer or mobile phone, as well as monitoring the computer, if   the test is computerized (since it allows the option of taking computerized or paper-based exams). There are already many computer tools that allow viewing the computer screen where the student takes the test and, in addition, there are special browsers for e-proctoring that prevent the student from leaving the exam screen and only taking the test without consulting any other application or program on that computer. Systems such as Remote Proctor NOW (RPNOW), eProctoring, SMOWL or ProctorExams, use their own systems to ensure control of the computer on which the student performs the test. This implies that the online educational system is greatly favored by its appearance, by allowing its evaluation process to be carried out remotely and the physical presence of the student in a specific place not being required. However, its advantages are not included in this alone, since the use of this tool also allows the adaptability of the exams to define the level of the student on a scale, such as that of the European Framework of Reference for Languages or in Adaptive Tests.

SYSTEM ANALYSIS

3.1 PROPOSED SYSTEM

The main objective of the Online Examination System is that it helps educational institutions and the corporate world to conduct exams to any number of candidates at a time, in an automated manner. It reduces the time consumption and work load that exist in the current system of examination. It also helps in storing the record of each examination and the results are also stored in the system. This makes the searching of the records easier than the existing system.

CHARACTERISTIC OF THE PROPOSED SYSTEM:

- The online test created for taking online tests has the following features In comparison to the present system the proposed system will be less time consuming and is more efficient.

- It will be able to detect most types of cheating like use of mobile phones, multiple people attempting one quiz, trying to cheat from external resources like books or secondary display, etc.

- Analysis will be very easy in the proposed system as it is automated.

- Results will be very precise and accurate and will be declared in a very short span of time because calculation and evaluations are done by the simulator itself.

- The proposed system is very secure as no chances of leakage of question paper as it is dependent on the administrator only.

- The logs of appeared candidates and their marks are stored and can be backup for future use.

3.2 FEASIBILITY STUDY

3.2.1 ECONOMICAL

Economic analysis is most frequently used for evaluation of the effectiveness of the system. More commonly known as cost/benefit analysis the procedure is to determine the benefit and saving that are expected from a system and compare them with costs, decisions are made to design and implement the system. This part of the feasibility study gives the top management the economic justification for the new system. This is an

important input to the management, because very often the top management does not like to get confused by the various technicalities that are bound to be associated with a project of this kind. A simple economic analysis that gives the actual comparison of costs and benefits is much more meaningful in such cases. In the system, the organization is most satisfied by economic feasibility. Because, if the organization implements this system, it need not require any additional hardware resources as well as it will be saving a lot of time.

3.2.2 TECHNICAL

Technical feasibility centers on the existing manual system of the test management process and to what extent it can support the system. According to the feasibility analysis procedure the technical feasibility of the system is analyzed and the technical requirements such as software facilities, procedure, inputs are identified. It is also one of the important phases of the system development activities. The system offers greater levels of user friendliness combined with greater processing speed. Therefore, the cost of maintenance can be reduced. Since, processing speed is very high and the work is reduced from the maintenance point of view, management is convinced that the project is operationally feasible.

3.2.3 BEHAVIORAL

People are inherently resistant to change and computers have been known to facilitate changes. An estimate should be made of how strong the user is likely to move towards the development of a computerized system. These are various levels of users in order to ensure proper authentication and authorization and security of sensitive data of the organization.

3.3 FUNCTIONAL REQUIREMENTS

The following requirements define the goals of the project outlined in the introduction. The functional requirements define features that must be done for the project to be considered a success, while the nonfunctional requirements define how the functional requirements are achieved. Requirements are categorized into critical, recommended, and suggested. Critical requirements are absolutely necessary, recommended are highly desirable, and suggested requirements are not necessary but would be very nice to add.

Critical:

    1. Must be able to register the student and teacher.

    2. Must be connected to the web .

    3. Must be able to give access to web cam in E-Xam .

Recommended:

    1. Direct contact to the Examiner.

    2. Security of information provided by Student

3.4 NON FUNCTIONAL REQUIREMENTS

A Non-functional requirement (NFR) is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviors. They are contrasted with functional requirements that define specific behavior or functions.

Critical:

    1. A simpler user interface.

    2. Website has good performance for users.

    3. Website maintains good reliability for users.

Recommended:

    1. A friendly user interface that works by selecting modules.

3.5 SYSTEM REQUIREMENTS

3.5.1 HARDWARE & SOFTWARE REQUIREMENTS

- **Client:**
  - Laptop/ desktop must be enabled with webcam and microphone. Webcam should capture image clearly. Both webcam and microphone must be in switch-on mode across all assessments.

- o RAM & Processor: 4 GB+ RAM, i3 5th Generation 2.2 Ghz or equivalent/ higher.
- o Operating system: Any (Windows, Linux, MacOS).
- o Google Chrome browser, version 80 (upto 5 latest versions considered)
- o Stable Internet connection of 2Mbps+ enabled through broadband connection, do avoid unstable 3G/4G networks.
- o VPN/Proxy should be disabled.
- **Server:**
  - o Operating System: Linux.
  - o Server: Gunicorn.
  - o Cloud Deployment Service: Heroku.
  - o Database: SQLite.

3.6 **TECHNOLOGY STACK**

Software required for development of website:

- Python 3.6
- Visual Studio Code
- Git
- Github
- Anaconda Navigator(anaconda3)

Libraries Required:

- backcall
- bcrypt==3.2.0
- bidict==0.21.2
- blinker==1.4
- certifi==2020.12.5
- cffi==1.14.5
- click==8.0.1
- colorama
- dataclasses==0.8
- decorator
- dnspython==2.1.0
- email-validator==1.1.2
- Flask==2.0.1
- Flask-Bcrypt==0.7.1

- Flask-Cors==3.0.10
- Flask-Login==0.5.0
- Flask-Mail==0.9.1
- Flask-SocketIO==5.0.3
- Flask-SQLAlchemy==2.5.1
- Flask-WTF==0.15.0
- greenlet==1.1.0
- idna==3.1
- importlib-metadata==4.0.1
- ipython
- ipython-genutils
- itsdangerous==2.0.1
- jedi==0.17.0
- Jinja2==3.0.1
- MarkupSafe==2.0.1
- parso
- pickleshare
- prompt-toolkit
- pycparser==2.20
- pygal==2.4.0
- Pygments
- python-engineio==4.2.0
- python-socketio==5.3.0
- six
- SQLAlchemy==1.4.15
- traitlets==4.3.3
- typing-extensions==3.10.0.0
- wcwidth
- Werkzeug==2.0.1
- wincertstore==0.2
- WTForms==2.3.3
- zipp==3.4.1

3.6.1 FLASK

Flask is a web application framework written in Python. It is developed by Armin Ronacher, who leads an international group of Python enthusiasts named Pocco. Flask is based on the Werkzeug WSGI toolkit and Jinja2 template engine. Both are Pocco projects.The Flask which is a backend framework of Python that is designed to make the development process smoother.Flask is a micro web framework written in Python. It is classified as a microframework because it does not require particular tools or libraries. It

has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions. However, Flask supports extensions that can add application features as if they were implemented in Flask itself. Extensions exist for object-relational mappers, form validation, upload handling, various open authentication technologies and several common framework related tools.

Flask is part of the categories of the micro-framework. Micro-framework are normally framework with little to no dependencies to external libraries. This has pros and cons. Pros would be that the framework is light, there are little dependency to update and watch for security bugs, cons is that some time you will have to do more work by yourself or increase yourself the list of dependencies by adding plugins.

3.6.2 **WSGI**

Web Server Gateway Interface (WSGI) has been adopted as a standard for Python web application development. WSGI is a specification for a universal interface between the web server and the web applications.

3.6.3 WERKZEUG

It is a WSGI toolkit, which implements requests, response objects, and other utility functions. This enables building a web framework on top of it. The Flask framework uses Werkzeug as one of its bases.

3.6.4 JINJA

Jinja templating engine was used as we used Flask for the backend of the website.Jinja is a fast, expressive, extensible templating engine. Special placeholders in the template allow writing code similar to Python syntax. Then the template is passed data to render the final document.

It includes:

- Template inheritance and inclusion.
- Define and import macros within templates.
- HTML templates can use autoescaping to prevent XSS from untrusted user input.
- A sandboxed environment can safely render untrusted templates.
- Async support for generating templates that automatically handle sync and async functions without extra syntax.

- I18N support with Babel.
- Templates are compiled to optimized Python code just-in-time and cached, or can be compiled ahead-of-time.
- Exceptions point to the correct line in templates to make debugging easier.
- Extensible filters, tests, functions, and even syntax.

Jinja's philosophy is that while application logic belongs in Python if possible, it shouldn't make the template designer's job difficult by restricting functionality too much.

Jinja uses a central object called the template Environment. Instances of this class are used to store the configuration and global objects, and are used to load templates from the file system or other locations. Even if we are creating templates from strings by using the constructor of Template class, an environment is created automatically for us, albeit a shared one.

Most applications will create one Environment object on application initialization and use that to load templates. In some cases however, it's useful to have multiple environments side by side, if different configurations are in use.

The simplest way to configure Jinja to load templates for application is to use PackageLoader.

3.6.5 MOBILENET

MobileNets are small, low-latency, low-power models parameterized to meet the resource constraints of a variety of use cases. They can be built upon for classification, detection, embeddings and segmentation similar to how other popular large scale models, such as Inception, are used. MobileNets can be run efficiently on mobile devices with TensorFlow Lite. MobileNets are a family of mobile-first computer vision models for TensorFlow, designed to effectively maximize accuracy while being mindful of the restricted resources for an on-device or embedded application.

In recent years, neural networks and deep learning have sparked tremendous progress in the field of natural language processing (NLP) and computer vision.

While many of the face, object, landmark, logo, and text recognition and detection technologies are provided for Internet-connected devices, we believe that the ever-increasing computational power of mobile devices can enable the delivery of these

technologies into the hands of users anytime, anywhere, regardless of Internet connection.

However, computer vision for on-device and embedded applications faces many challenges—models must run quickly with high accuracy in a resource-constrained environment, making use of limited computation, power, and space.

TensorFlow offers various pre-trained models, such as drag-and-drop models, in order to identify approximately 1,000 default objects.

When compared with other similar models, such as the Inception model datasets, MobileNet works better with latency, size, and accuracy. In terms of output performance, there is a significant amount of lag with a full-fledged model.

However, the trade-off is acceptable when the model is deployable on a mobile device for real-time offline detection.

3.6.6 TENSORFLOW

Deep learning is a subfield of machine learning that is a set of algorithms that is inspired by the structure and function of the brain.TensorFlow is the second machine learning framework that Google created and used to design, build, and train deep learning models.

The TensorFlow library does numerical computations, which in itself doesn't seem all too special, but these computations are done with data flow graphs. In these graphs, nodes represent mathematical operations, while the edges represent the data, which usually are multidimensional data arrays or tensors, that are communicated between these edges.The name "TensorFlow" is derived from the operations which neural networks perform on multidimensional data arrays or tensors! It's literally a flow of tensors.

TensorFlow allows developers to create dataflow graphs—structures that describe how data moves through a graph, or a series of processing nodes. Each node in the graph represents a mathematical operation, and each connection or edge between nodes is a multidimensional data array, or tensor.

TensorFlow provides all of this for the programmer by way of the Python language. Python is easy to learn and work with, and provides convenient ways to express how high-level abstractions can be coupled together. Nodes and tensors in TensorFlow are Python objects, and TensorFlow applications are themselves Python applications.

The single biggest benefit TensorFlow provides for machine learning development is abstraction. Instead of dealing with the nitty-gritty details of implementing algorithms, or figuring out proper ways to hitch the output of one function to the input of another, the developer can focus on the overall logic of the application. TensorFlow takes care of the details behind the scenes.

TensorFlow offers additional conveniences for developers who need to debug and gain introspection into TensorFlow apps. The eager execution mode lets you evaluate and modify each graph operation separately and transparently, instead of constructing the entire graph as a single opaque object and evaluating it all at once. The TensorBoard visualization suite lets you inspect and profile the way graphs run by way of an interactive, web-based dashboard.

It contains a few breaking changes, details of which are listed below, but at a high level these are some of the major changes in this release:

The CPU and WebGL backends have moved out of tfjs-core into their own packages. tfjs-backend-cpu and tfjs-backend-webgl.

If you are not using the union package (i.e. you use tfjs-core, tfjs-layers, tfjs-converter, tfjs-data directly) you need to import these backends into your application to get the same behavior as before, or you can only import a single backend if that is all you need.

If you use the union package (i.e. tfjs), then nothing will need to change in your code as these backends are already included.

In some situations (e.g. running certain ops with small tensors) the WebGL backend can optionally fall back to the CPU backend, to keep this behavior, for those not using the union package you should include both the cpu and webgl backend in your application. We are working towards saving you this step in 3.x. If you primarily rely on the WebGL backend, you should test the performance with and without the CPU backend present and make the appropriate decision of what to include.

In addition to our ES5 bundles, we are shipping new pre-compiled bundles with ES modules and ES2017 code:

- tf.min.js & tf.es2017.min.js
- tf-core.min.js & tf-core.es2017.min.js

- tf-backend-cpu.min.js & tf-backend-cpu.es2017.min.js

- tf-backend-webgl.min.js & tf-backend-webgl.es2017.min.js

- tf-layers.min.js & tf-layers.es2017.min.js

- tf-converter.min.js & tf-converter.es2017.min.js

- tf-data.min.js & tf-data.es2017.min.js

3.6.7 TENSORFLOW.JS

TensorFlow.js is an open-source hardware-accelerated JavaScript library for training and deploying machine learning models.TensorFlow.js Data provides simple APIs to load and parse data from disk or over the web in a variety of formats, and to prepare that data for use in machine learning models (e.g. via operations like filter, map, shuffle, and batch).TensorFlow.js Data provides simple APIs to load and parse data from disk or over the web in a variety of formats, and to prepare that data for use in machine learning models (e.g. via operations like filter, map, shuffle, and batch).

This project is the JavaScript analogue of tf.data on the Python/C++ side. TF.js Data will match the tf.data API to the extent possible.

Develop ML in the Browser

Use flexible and intuitive APIs to build models from scratch using the low-level JavaScript linear algebra library or the high-level layers API.

Develop ML in Node.js

Execute native TensorFlow with the same TensorFlow.js API under the Node.js runtime.

Run Existing models

Use TensorFlow.js model converters to run pre-existing TensorFlow models right in the browser.

Retrain Existing models

Retrain pre-existing ML models using sensor data connected to the browser or other client-side data.

3.6.8 WEBGAZER:

WebGazer.js is an eye tracking library that uses common webcams to infer the eye-gaze locations of web visitors on a page in real time. The eye tracking model it contains self-calibrates by watching web visitors interact with the web page and trains a mapping between the features of the eye and positions on the screen. WebGazer.js is written entirely in JavaScript and with only a few lines of code can be integrated in any website that wishes to better understand their visitors and transform their user experience. WebGazer.js runs entirely in the client browser, so no video data needs to be sent to a server. WebGazer.js can run only if the user consents in giving access to their webcam.

Features:

- Real time gaze prediction on most major browsers
- No special hardware; WebGazer.js uses your webcam
- Self-calibration from clicks and cursor movements
- Easy to integrate with a few lines of JavaScript
- Swappable components for eye detection
- Multiple gaze prediction models
- Useful video feedback to user

3.6.9 HTML

HTML is the standard markup language for Web pages. HTML stands for Hyper Text Markup Language. It is the standard markup language for creating Web pages. HTML describes the structure of a Web page. It consists of a series of elements, HTML elements tell the browser how to display the content. HTML elements label pieces of content such as "this is a heading", "this is a paragraph", "this is a link", etc.

The purpose of a web browser (Chrome, Edge, Firefox, Safari) is to read HTML documents and display them correctly.

3.6.10 BOOTSTRAP

Bootstrap is a most popular front end framework in the recent time. It is sleek, intuitive, and powerful mobile first front-end framework for faster and easier web development. It uses HTML, CSS and Javascript.We use Bootstrap framework for responsive web application.This was done to give us the maximum amount of control over the UI and

not be constrained on anything framework-specific for working on the UX.Responsive web design is about creating web sites which automatically adjust themselves to look good on all devices, from small phones to large desktops.

Advantages of Bootstrap:

- Easy to use: Anybody with just basic knowledge of HTML and CSS can start using Bootstrap.
- Responsive features: Bootstrap's responsive CSS adjusts to phones, tablets, and desktops.
- Mobile-first approach: In Bootstrap, mobile-first styles are part of the core framework.
- Browser compatibility: Bootstrap 4 is compatible with all modern browsers (Chrome, Firefox, Internet Explorer 10+, Edge, Safari, and Opera).

3.6.11 **CSS**

Cascading Style Sheets is a style sheet language used for describing the presentation of a document written in a markup language such as HTML. CSS is a cornerstone technology of the World Wide Web, alongside HTML and JavaScript. CSS is used to define styles for your web pages, including the design, layout and variations in display for different devices and screen sizes.

3.6.12 **JAVASCRIPT**

JavaScript, often abbreviated as JS, is a programming language that conforms to the ECMAScript specification. JavaScript is high-level, often just-in-time compiled, and multi-paradigm. It has curly-bracket syntax, dynamic typing, prototype-based object-orientation, and first-class functions. We use JavaScript for models and other form validations in E-Xam.

In HTML, JavaScript code is inserted between <script> and </script> tags.Old JavaScript examples may use a type attribute: <script type="text/javascript">. The type attribute is not required. JavaScript is the default scripting language in HTML.

A JavaScript function is a block of JavaScript code, which can be executed when "called" for. For example, a function can be called when an event occurs, like when the user clicks a button.

3.6.13 PYTHON

Python is an interpreted high-level general-purpose programming language. Python's design philosophy emphasizes code readability with its notable use of significant indentation. Its language constructs as well as its object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects. Features like E-mail verification, handling routes, performing checks and validations and, the performance analytics section are part of the backend made using Python.

Institutions that use their own onsite infrastructure consisting hardware such as servers and intranet often face problems such as crashes on high traffic and application and website shutdowns for maintenance purposes. The once that use cloud services have their own set of problems. We have used services from GCP's toolbox such as GKE On-prem and Anthos for developing a hybrid model of onsite and cloud deployment. Using this the interested customers can take the advantages of both.

These components provide an end-to-end framework for developers to work in.

- Python can be used on a server to create web applications.
- Python can be used alongside software to create workflows.
- Python can connect to database systems. It can also read and modify files.
- Python can be used to handle big data and perform complex mathematics.
- Python can be used for rapid prototyping, or for production-ready software development.

Why Python?

- Python works on different platforms (Windows, Mac, Linux, Raspberry Pi, etc).
- Python has a simple syntax similar to the English language.
- Python has syntax that allows developers to write programs with fewer lines than some other programming languages.
- Python runs on an interpreter system, meaning that code can be executed as soon as it is written. This means that prototyping can be very quick.
- Python can be treated in a procedural way, an object-oriented way or a functional way.

3.6.14 NODE PACKAGE MANAGER (NPM)

npm (originally short for Node Package Manager is a package manager for the JavaScript programming language.npm, Inc. is a subsidiary of GitHub (a subsidiary of Microsoft), that provides hosting for software development and version control with the usage of Git.

npm is the default package manager for the JavaScript runtime environment Node.js. It consists of a command line client, also called npm, and an online database of public and paid-for private packages, called the npm registry. The registry is accessed via the client, and the available packages can be browsed and searched via the npm website. The package manager and the registry are managed by npm, Inc.npm is included as a recommended feature in the Node.js installer. npm consists of a command line client that interacts with a remote registry. It allows users to consume and distribute JavaScript modules that are available in the registry. Packages in the registry are in CommonJS format and include a metadata file in JSON format. Over 1.3 million packages are available in the main npm registry. The registry does not have any vetting process for submission, which means that packages found there can potentially be low quality, insecure, or malicious. Instead, npm relies on user reports to take down packages if they violate policies by being low quality, insecure, or malicious. npm exposes statistics including number of downloads and number of depending packages to assist developers in judging the quality of packages.

In npm version 6, the audit feature was introduced to help developers identify and fix security vulnerabilities in installed packages. The source of security vulnerabilities were taken from reports found on the Node Security Platform (NSP) and has been integrated with npm since npm's acquisition of NSP.

npm can manage packages that are local dependencies of a particular project, as well as globally-installed JavaScript tools. When used as a dependency manager for a local project, npm can install, in one command, all the dependencies of a project through the package.json file In the package.json file, each dependency can specify a range of valid versions using the semantic versioning scheme, allowing developers to auto-update their packages while at the same time avoiding unwanted breaking changes. npm also provides version-bumping tools for developers to tag their packages with a particular

version. npm also provides the package-lock.json file which has the entry of the exact version used by the project after evaluating semantic versioning in package.json.

SYSTEM DESIGN

4.1 SYSTEM ARCHITECTURE

Since the application have client server architecture, it will have two tier-architecture.
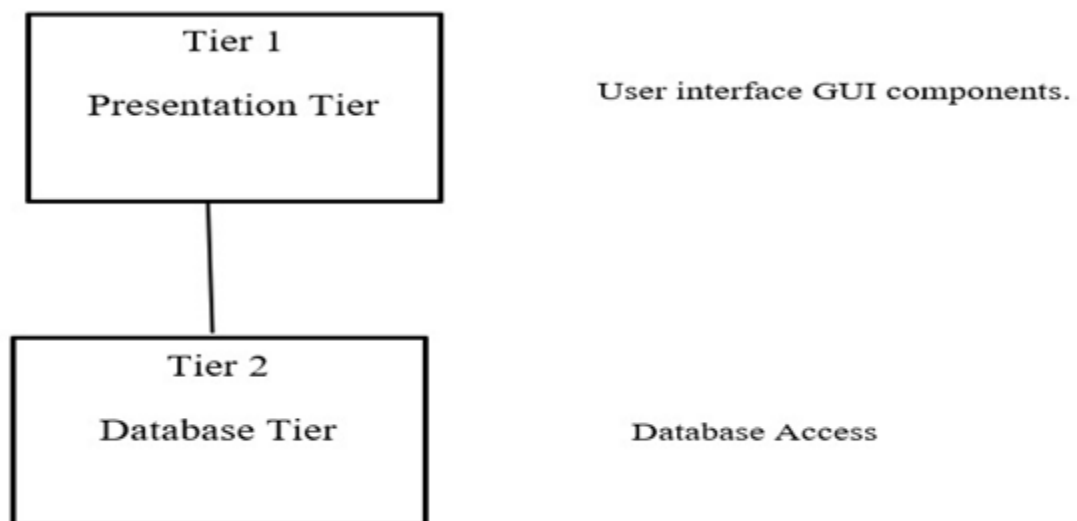
Figure 4.1: System Architecture

4.1.1 DESIGN OF SYSTEM

Teachers and Students are two kinds of users of the system. And then the system is divided into three function blocks for services may be provided for these three kinds of different types of users.

4.1.2 OVERALL DESIGN

The whole system is divided into two modules: administrator module, teacher module and student module. The teacher module includes maintenance of teacher information, student-user management, test management module, automatic organizing of examination-paper, examination-paper management, examination-paper analysis, result statistics and so on; Student module includes student information maintenance, online examination, score inquiries and other functions.

4.2 **UML DIAGRAMS**

4.2.1 USE CASE DIAGRAMS
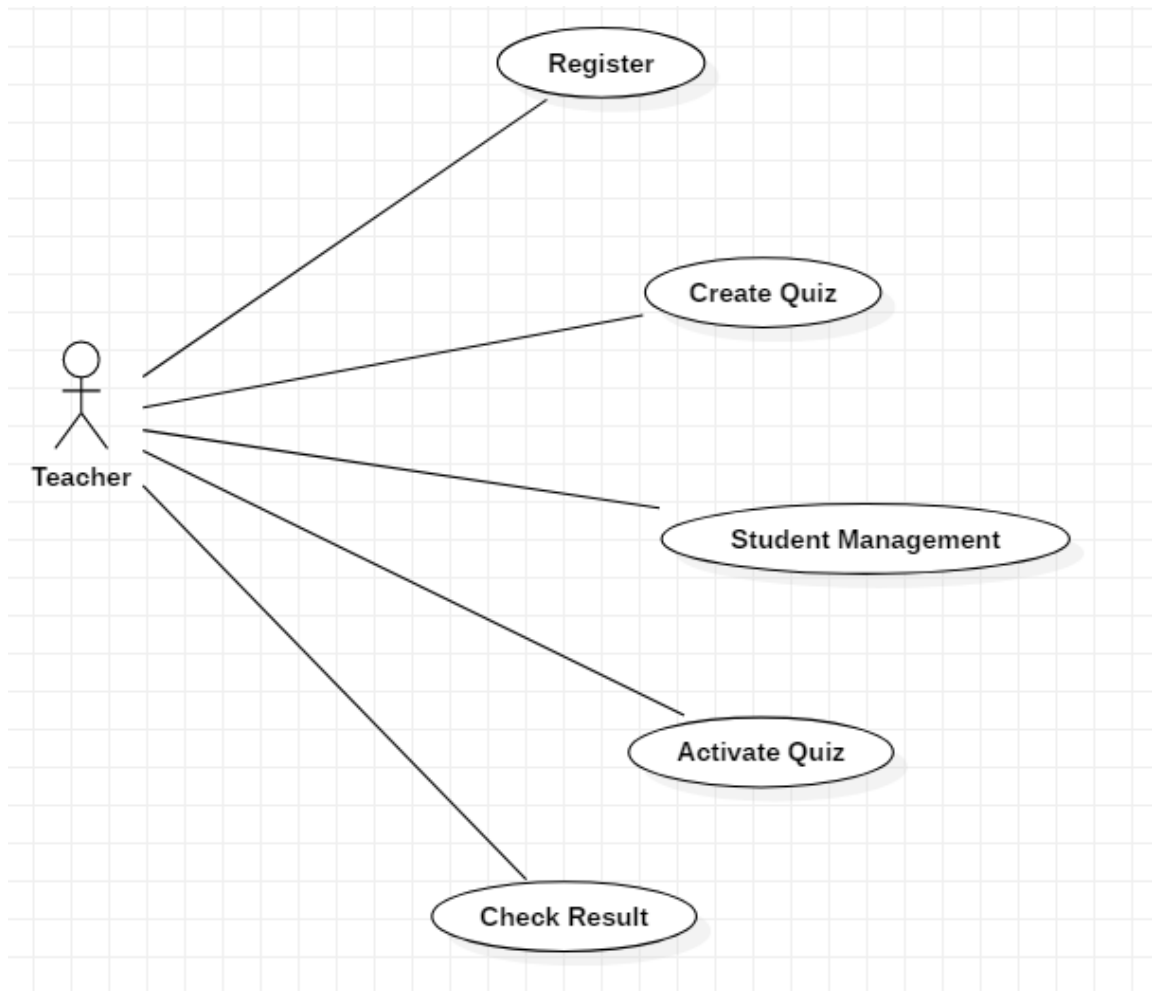
Figure 4.2: Use Case – Teacher

This is the Use case Diagram for the Teacher. As the Teacher is the super user of the system all the permissions and privileges. The facilities that Teacher can provide is Add Quiz, Add Student i.e Student management, Activate Quiz, Check result. The Teacher is the Actor and others are the use case.
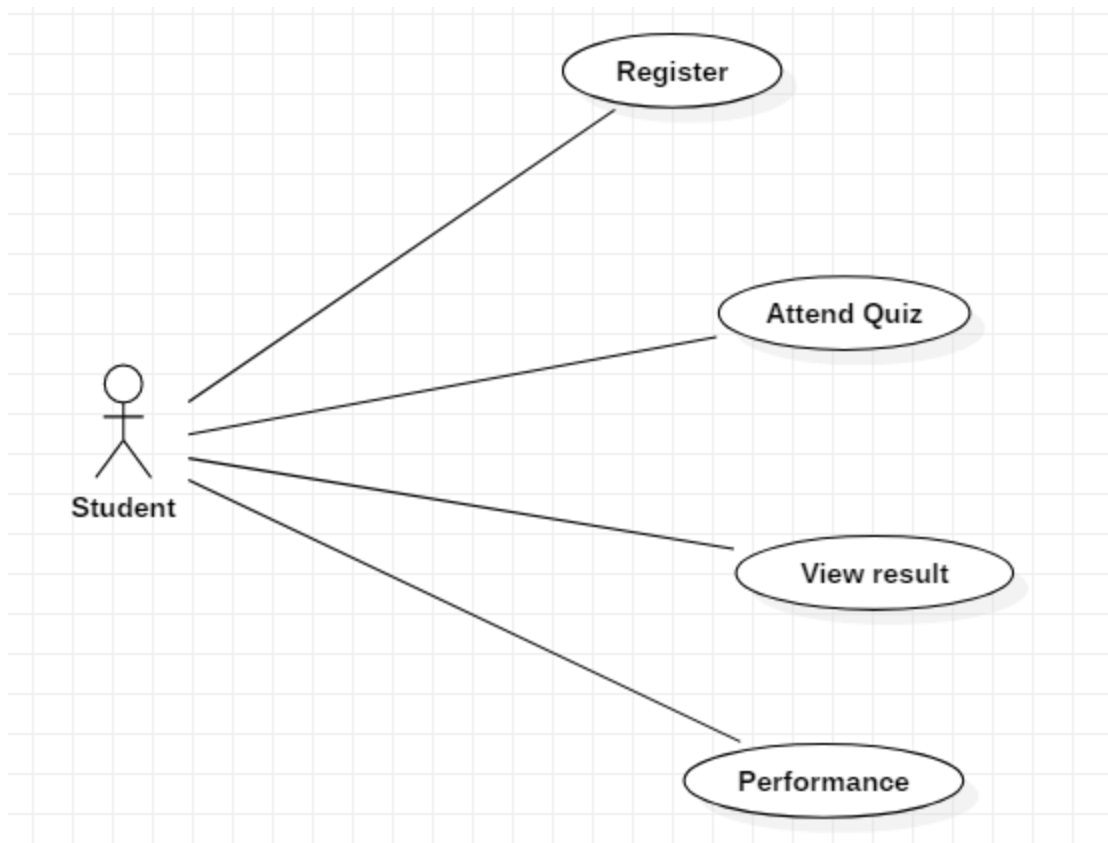
Figure 4.3: Use Case – Student

This is the Use case Diagram for the Student. The facilities provided to Student are Attend Quiz, view result. The Student is the Actor and others are the use case.
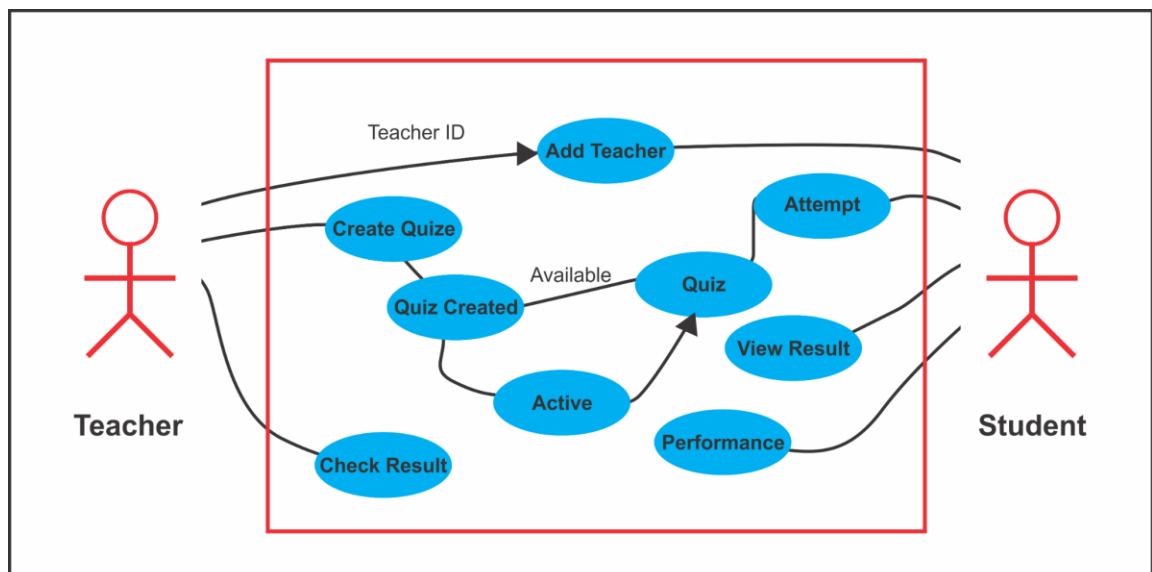
Figure 4.4: Use Case - All Users

This is the Use case Diagram of both teacher and student. In this diagram It shows how the system works.

4.2.2 ACTIVITY DIAGRAM
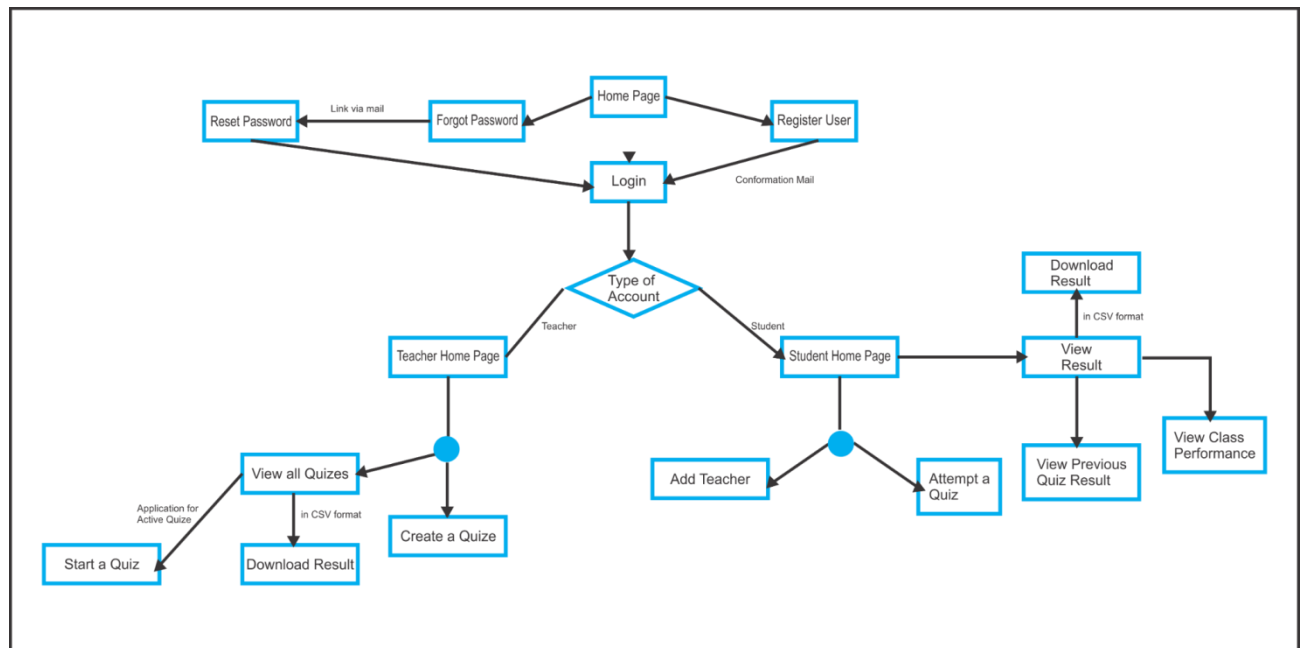
Figure 4.5: Activity Diagram

Activity diagram is another important diagram in UML to describe the dynamic aspects of the system. Activity diagram is basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system. The control flow is drawn from one operation to another. Activity diagrams captures the dynamic behavior of the system. Activity diagram is used to show message flow from one activity to another.

Activity is a particular operation of the system. Activity diagrams are not only used for visualizing the dynamic nature of a system, but they are also used to construct the executable system by using forward and reverse engineering techniques. The only missing thing in the activity diagram is the message part.

It does not show any message flow from one activity to another. Activity diagram is sometimes considered as the flowchart. Although the diagrams look like a flowchart, they are not. It shows different flows such as parallel, branched, concurrent, and single.

Activity diagram is suitable for modeling the activity flow of the system. An application can have multiple systems. Activity diagram also captures these systems and describes the flow from one system to another. This specific usage is not available in other diagrams. These systems can be database, external queues, or any other system.

4.3 **DATABASE DESIGN**

It is very important for the Network Examination System, which needs a lot of data processing and data storage, to establish a simple and efficient Database System. Prior to the establishment of the database, it is required to use the E-R diagram to study the relationship among the data entities such as administrators, teachers, students, examination papers, examination questions, questions library and so on. An examination paper is composed of examination questions while a question may appear in different papers. Each entity has its own properties. For the limited space, only several key entities will be introduced in the following diagram.
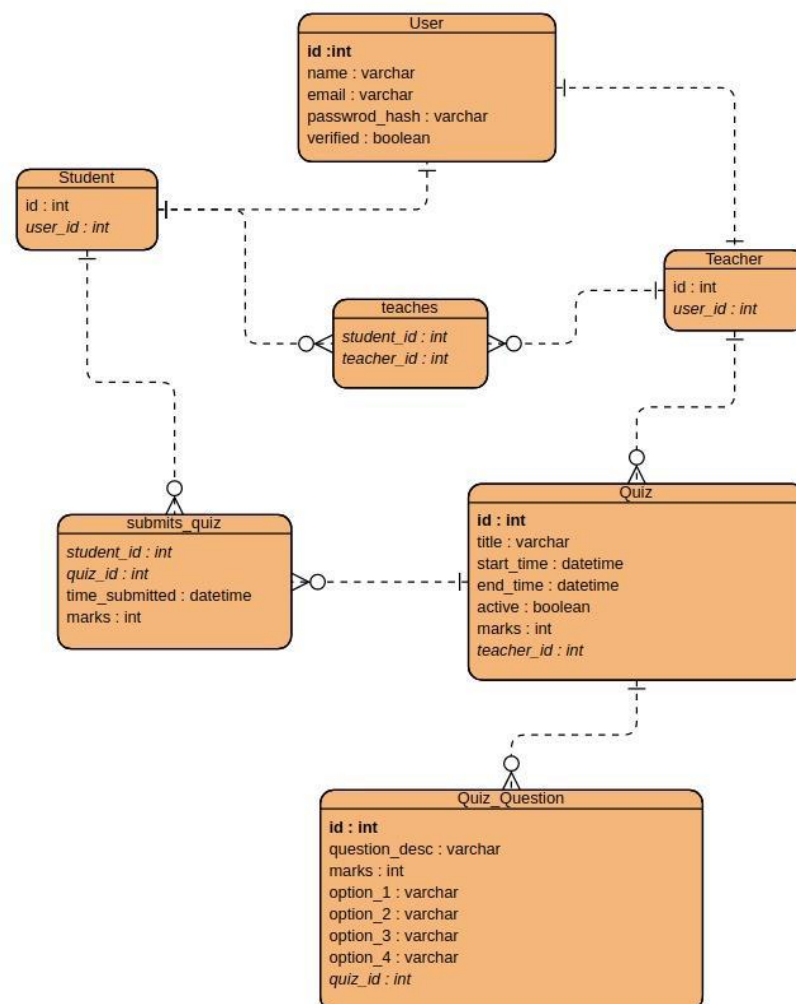
Figure 4.6: Database Design

4.3.1 STUDENT ENTITY

The student has several attributes such as student ID, name, professional class, examination card number, password, contact information and so on. Attributes with details are shown in Figure.

4.3.2 EXAMINATION QUESTION ENTITY

The examination question entity mainly include: question ID number, question content, question type, difficulty degree, value, course name, correct answer, and etc. Attributes with details are shown in Figure

4.3.3 EXAMINATION PAPER ENTITY

An examination paper is a set of questions which are selected from a question library composed with a certain number of questions according to the procedure setting made by the teacher. Each examination paper contains a paper ID, a paper name, a question library ID, generation time, generator, contents of the paper, the total score of the examination paper, the beginning of the answer time, the end of the answer time and other information. Attributes with details are shown in Figure.

4.3.4 E-R DIAGRAM FOR EXAMINATION PAPER AND QUESTIONS

An examination paper is composed of a certain number of questions while a question may appear in different papers. The E-R Chart of examination paper and questions is shown in the Figure.
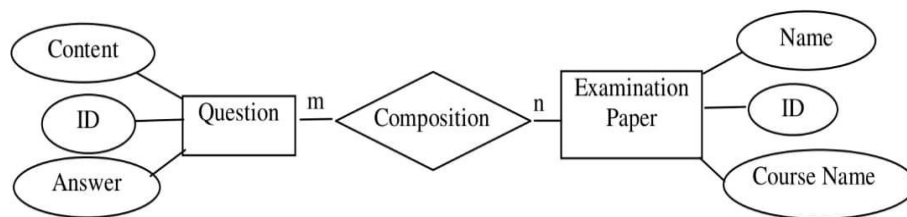
Figure 4.7: Question and Paper Relationship

Chapter 5
IMPLEMENTATION

5.1 IMPLEMENTATION DETAILS

5.1.1 AI-BASED REMOTE PROCTORING

AI-enabled Remote Proctoring focuses on the following three areas:

- Detect Identity Fraud
- Analyze cheating behavior
- Discover Content Theft

The AI-based remote proctoring process is repeated thousands of times to develop, train and refine every event defined in the system. An event can be a single behavior or indicative of identity fraud, content theft and cheating behavior.

For example, if someone is found looking off-screen to the left, it can be considered as a single data point and that specific portion of the video is segmented and labeled as unfair means. Once the number of such data points of the same behavior goes beyond the limit, the continuous event of building, training and refining is initiated.

Each of the thousands of events that execute through the process is categorized as potential fraud, theft or cheating. All the events would result in whether or not the session should be marked with a suspected breach of integrity.

A variety of AI technologies can be used to enhance remote proctoring services and provide an efficient way of organizing examinations to institutions.

5.1.2 NEURAL NETWORK

Neural Networks are complex structures made of artificial neurons that can take in multiple inputs to produce a single output. This is the primary job of a Neural Network – to transform input into a meaningful output. Usually, a Neural Network consists of an input and output layer with one or multiple hidden layers within.

In a Neural Network, all the neurons influence each other, and hence, they are all connected. The network can acknowledge and observe every aspect of the dataset at hand and how the different parts of data may or may not relate to each other. This is how

Neural Networks are capable of finding extremely complex patterns in vast volumes of data.

In a Neural Network, the flow of information occurs in two ways –

- Feedforward Networks: In this model, the signals only travel in one direction, towards the output layer. Feedforward Networks have an input layer and a single output layer with zero or multiple hidden layers. They are widely used in pattern recognition.

- Feedback Networks: In this model, the recurrent or interactive networks use their internal state (memory) to process the sequence of inputs. In them, signals can travel in both directions through the loops (hidden layer/s) in the network. They are typically used in time-series and sequential tasks.

input layer   hidden layer 1   hidden layer 2   output layer
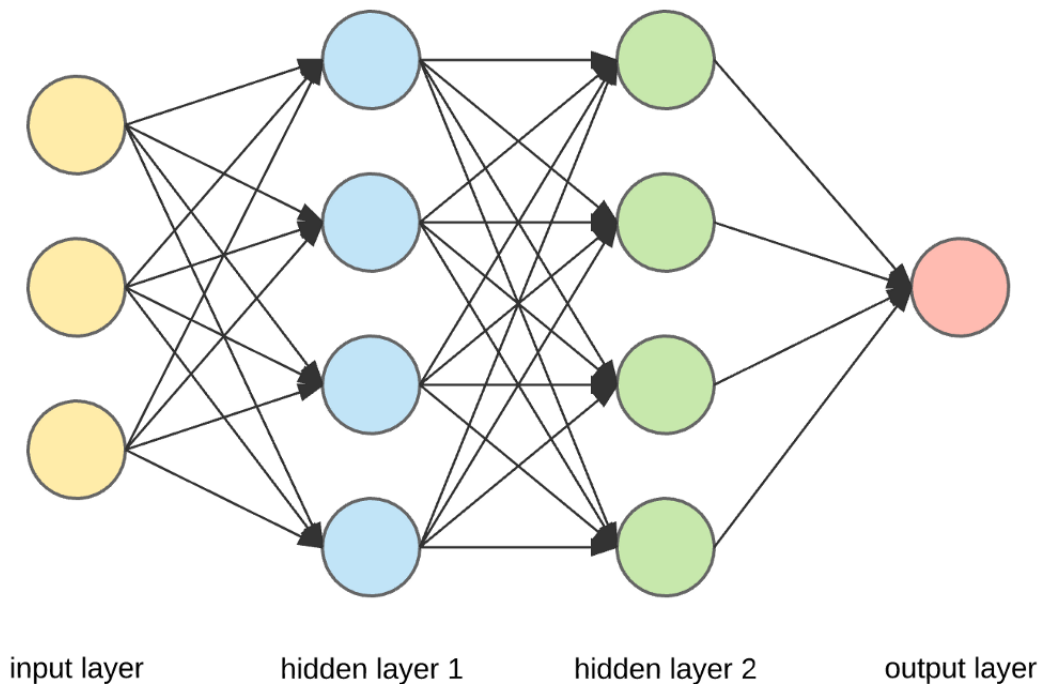
Figure 5.1: Neural Network Architecture

In the picture given above, the outermost yellow layer is the input layer. A neuron is the basic unit of a neural network. They receive input from an external source or other nodes. Each node is connected with another node from the next layer, and each such connection has a particular weight. Weights are assigned to a neuron based on its relative importance against other inputs.

When all the node values from the yellow layer are multiplied (along with their weight) and summarized, it generates a value for the first hidden layer. Based on the summarized

value, the blue layer has a predefined "activation" function that determines whether or not this node will be "activated" and how "active" it will be.

5.1.3 ALGORITHM

In a Neural Network, the learning (or training) process is initiated by dividing the data into three different sets:

- Training dataset – This dataset allows the Neural Network to understand the weights between nodes.
- Validation dataset – This dataset is used for fine-tuning the performance of the Neural Network.
- Test dataset – This dataset is used to determine the accuracy and margin of error of the Neural Network.

Once the data is segmented into these three parts, Neural Network algorithms are applied to them for training the Neural Network. The procedure used for facilitating the training process in a Neural Network is known as the optimization, and the algorithm used is called the optimizer. There are different types of optimization algorithms, each with their unique characteristics and aspects such as memory requirements, numerical precision, and processing speed.

5.1.4 LOSS FUNCTION

The loss function [$f(w)$] depends on the adaptive parameters – weights and biases – of the Neural Network. These parameters can be grouped into a single n-dimensional weight vector (w).
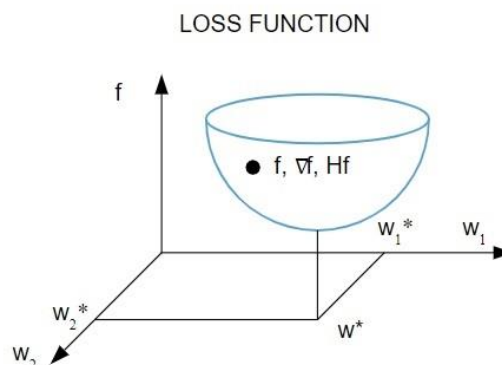
Figure 5.2: Loss Function Representation

5.1.5 FACE DETECTION

Face detection is a computer vision technology that helps to locate/visualize human faces in digital images. This technique is a specific use case of object detection technology that deals with detecting instances of semantic objects of a certain class (such as humans, buildings or cars) in digital images and videos. With the advent of technology, face detection has gained a lot of importance especially in fields like photography, security, and marketing. Proctoring can be classified into different types which are as follows:

- **Video Proctoring**

Video Proctoring is useful for high stake examinations where a candidate is monitored via a continuous video streaming activity. A candidate's video during the entire exam is recorded and the assessment controller checks if the student got involved in cheating or unfair means by analyzing their behavior from the video.

- **Image Proctoring**

Image proctoring is suitable where internet connectivity is not good. This proctoring type aims at verifying remote candidates multiple times randomly. The system would capture pictures of the candidate at specific time intervals, for example, exam start, end, questions attempted, after every 30 or 45 seconds.

Educational institutes can validate those images to ensure that an actual candidate has conducted an online exam and no malpractice has happened. Image proctoring is cost-effective as compared to video streaming quality.

- **Auto Proctoring**

If you want to do monitoring and analysis activity automatically for remote candidates, you can perform auto proctoring. It is used to conduct the continuous streaming activity of candidates sitting at remote locations for online assessment.

It performs the analysis of videos and images to identify if the candidate is indulged in cheating, such as the use of the mobile phone during the exam, someone assisting the candidate or candidate is using notes or reference books.

- **Candidate Identity Verification**

In this proctoring, the identity of the candidate is verified before the start of the online exam. The candidate is supposed to show an identity card and exam hall ticket in front of the camera.

The proctor sitting at a remote location verifies the identity card of the candidate and approves or rejects them based on submitted records.

As compared to the above methods of proctoring, automated proctoring is one of the best ways to use a webcam and screen-sharing program. In this proctoring, a human proctor is replaced with computer algorithms that can flag suspicious behavior.Using ML, AI-enabled remote proctoring systems can continuously learn, adapt and get smarter. The aim to introduce AI into proctoring is not to replace humans but to increase the accuracy of proctoring by helping humans in identifying details like low sound levels, whispers, reflections, shadows, etc.

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5.2 **FLOW OF SYSTEM**

There are three parts of implementation:

5.2.1 AUTHENTICATION

As we enter into the website we will have welcome page where all information about

E-Xam platform will be available as shown in image.
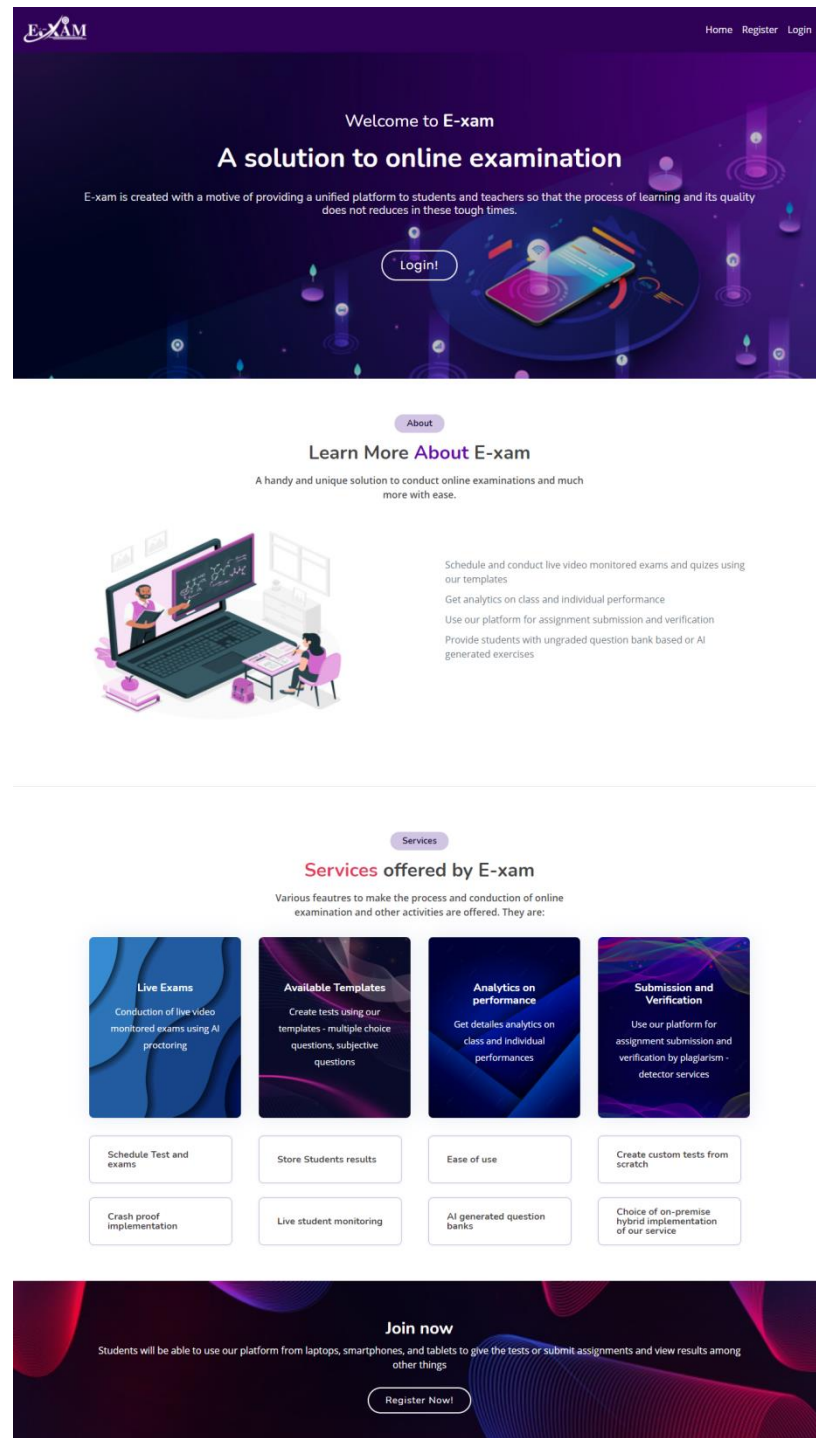
Figure 5.3: Welcome Page

Functionality 1: Registration

In sign up page there will be details asked to users such as name, email, password, confirm password, account type. For account type there are two options sign up as a Student or sign up as a Teacher.

Figure 5.4: Registration Page

After clicking on the sign up button, a link is generated to the respective email for verifying account. After click on that link user redirected to reset password page and it completes the registration process.

Figure 5.5: Email Verification
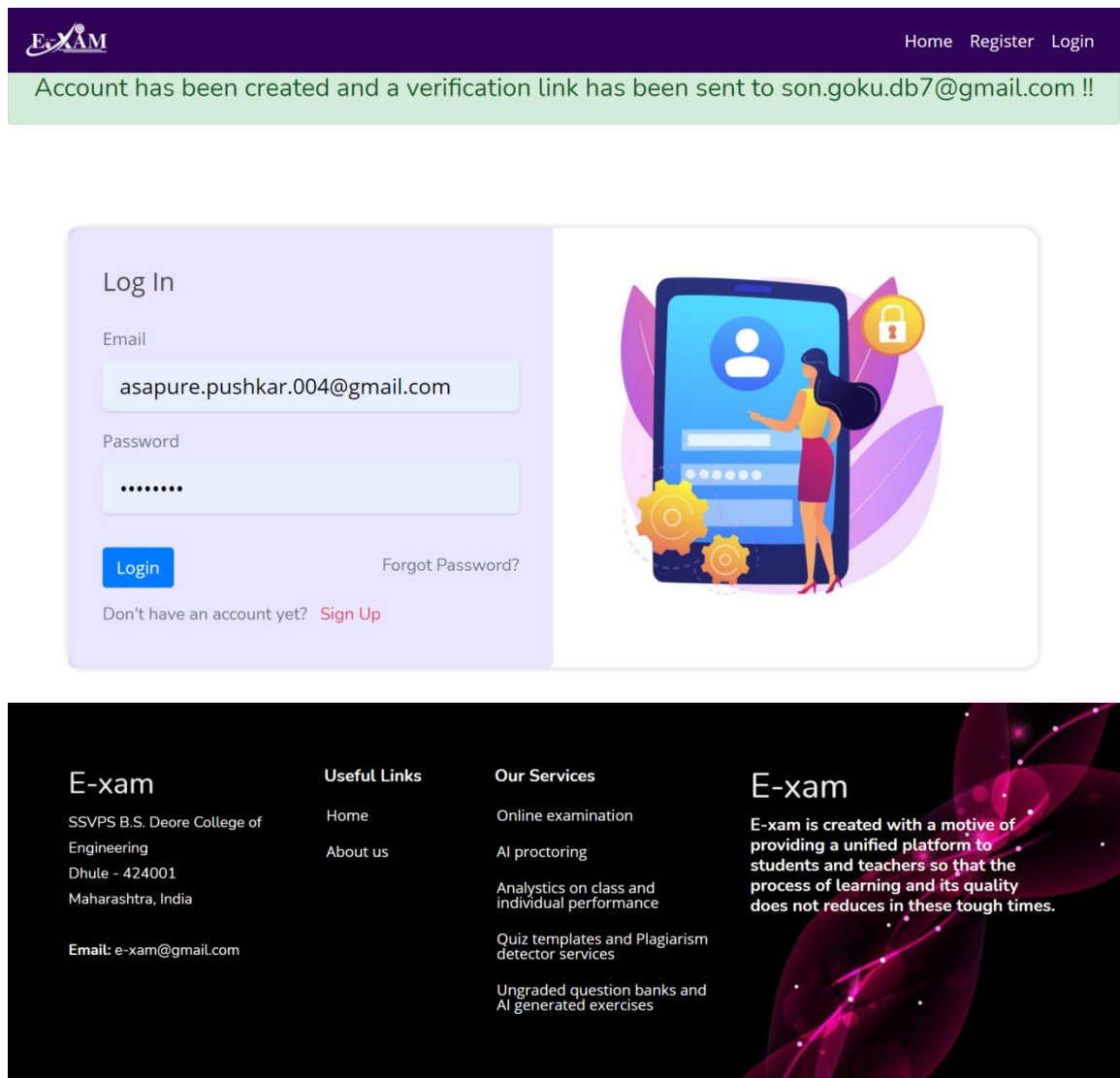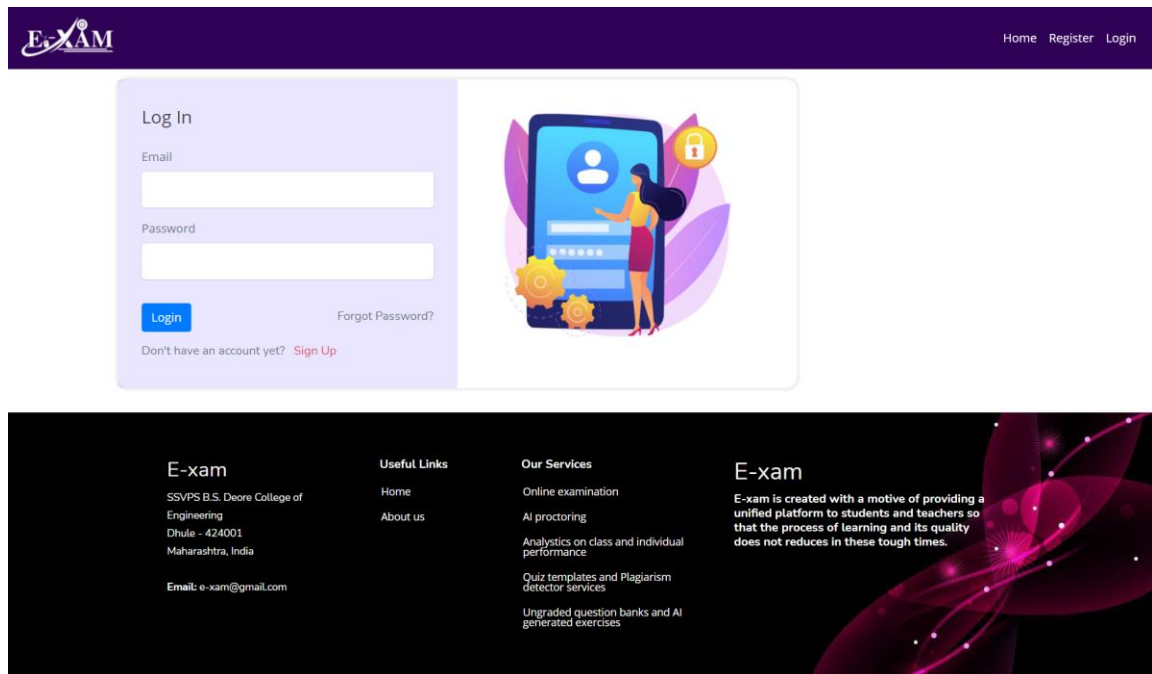
Figure 5.6: Account Verified
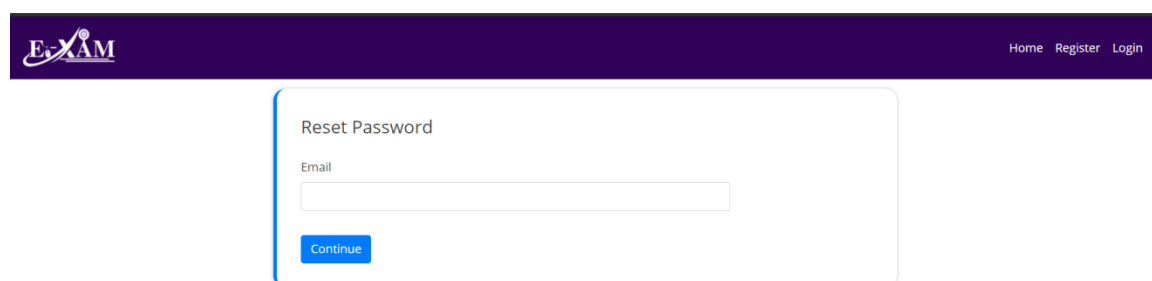
Functionality 2: Login

After completion of the registration process user can login to E-Xam portal. On login page user has to fill email and password for login. If in case the user forgets the password then click on forgot password button and the user will be redirected to the reset password page.

Figure 5.7: Login Page

Figure 5.8: Forgot Password

Figure 5.9: Reset Password

5.2.2 STUDENT

Functionality 3: Student Dashboard

After registration and login, if the user is a student then the student dashboard will be displayed.

Figure 5.10: Student Dashboard

Firstly students have to add teacher from add teacher by their teacher id number in dashboard. After that, students can attempt the quiz which is assigned to them. After attempting the quiz the student can check their results/marks from the view result in the dashboard. Students can check there performance by clicking on view performance.

Figure 5.11: Add Teacher

Figure 5.12: Assigned Quizzes

Functionality 4: AI Proctored Quiz

1) Objective question module

At present, the system supports objective questions, such as single topic selection, multiple choice, and judgment questions. This module involves unit tests and final examinations. Objective question module is the first part of tests that a student participates in. After students login in the subject selection page, select the corresponding subject and type of tests, then the system will automatically jump to a page of objective questions. On this page, students must finish the test within the given time. When students submit a paper, the system will record their answers to the database and show the correct answers and score of the objective questions. In addition, the system sets the test time depending on the type of tests. The time is displayed on the page of the test.
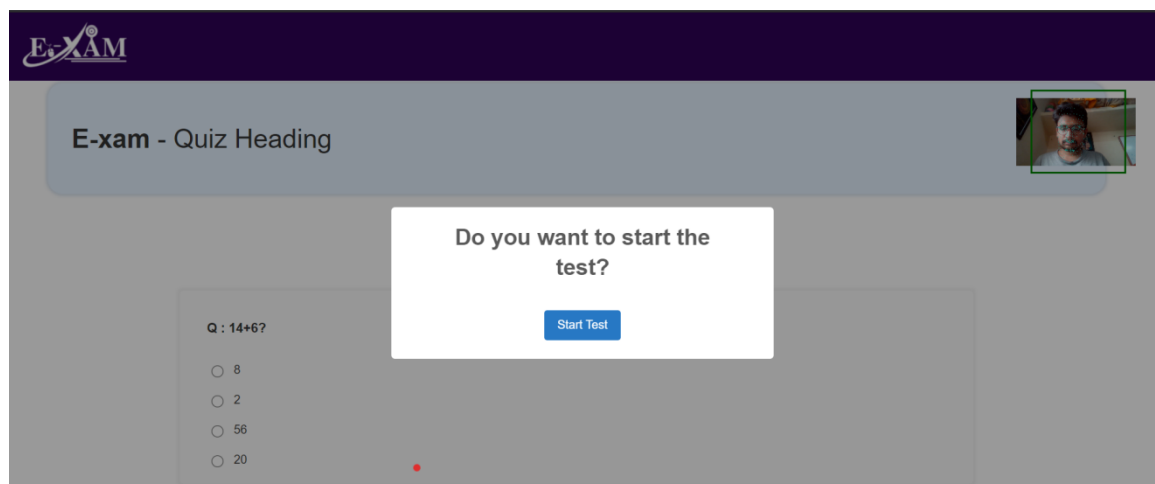

Figure 5.13: Proctored Quiz

2) AI Proctoring module

After clicking on the start test, full screen mode is on. If a student tries to change tabs then the following warning will occur. We detect this error five times and after that test will be automatically submitted.
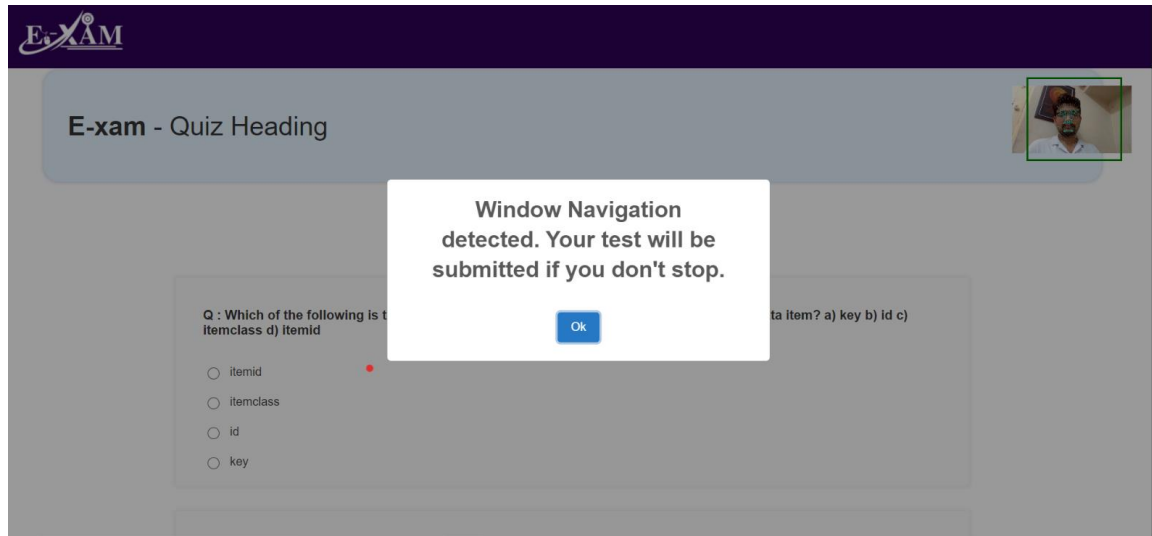

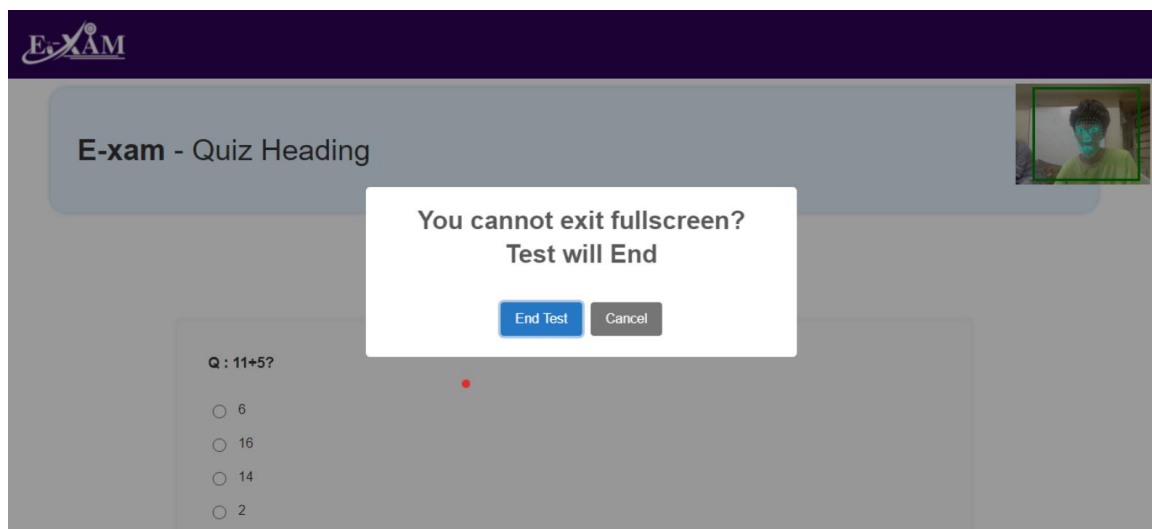**Figure 5.14: Trying to Navigate from test window**
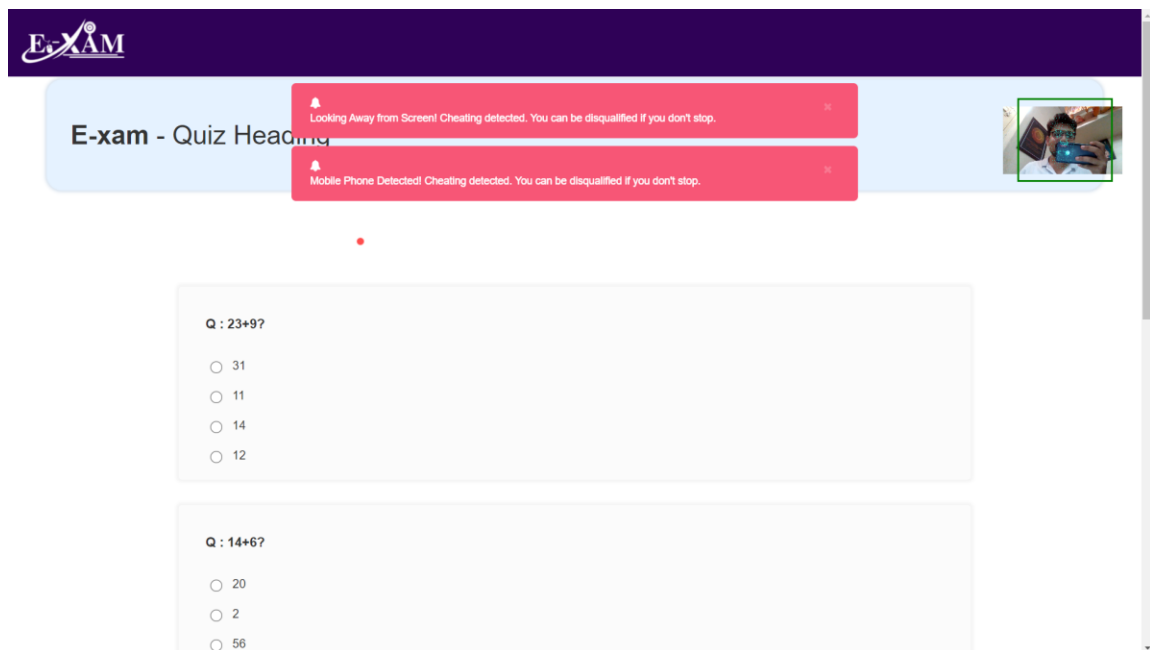

Figure 5.15: Trying to Exit Full screen Mode

Figure 5.16: Mobile Phone and Looking away warning

During Examination, if more than one person is detected in the webcam the proctoring system detects this type of cheating and warns the student that he/she will be disqualified if cheating does not stop.
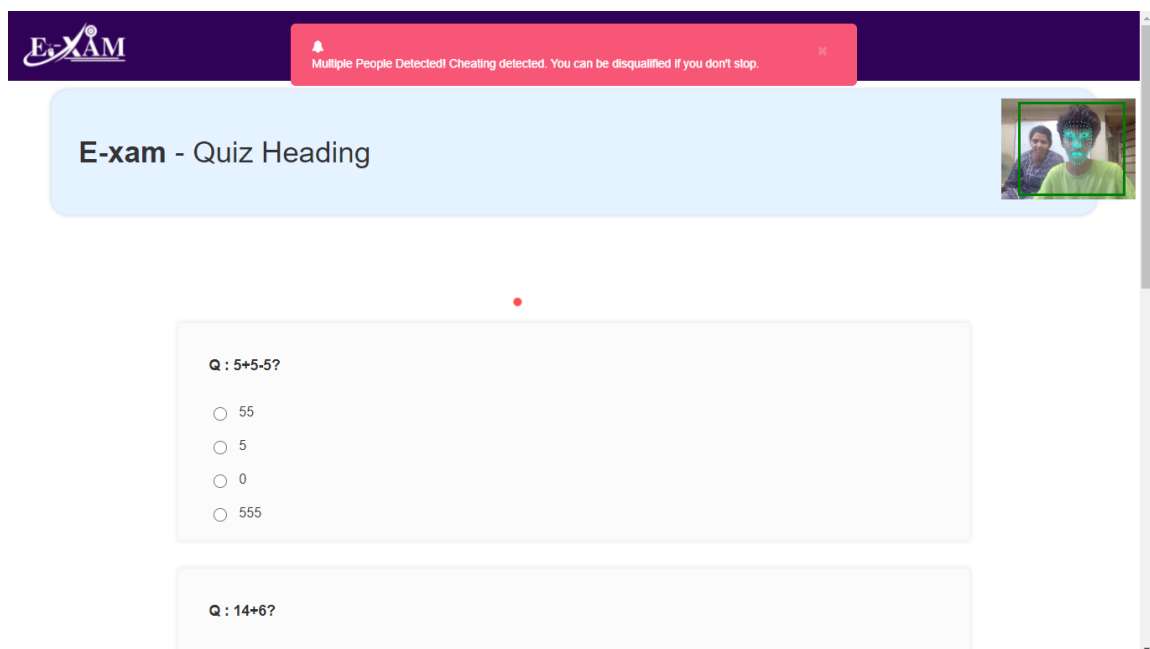

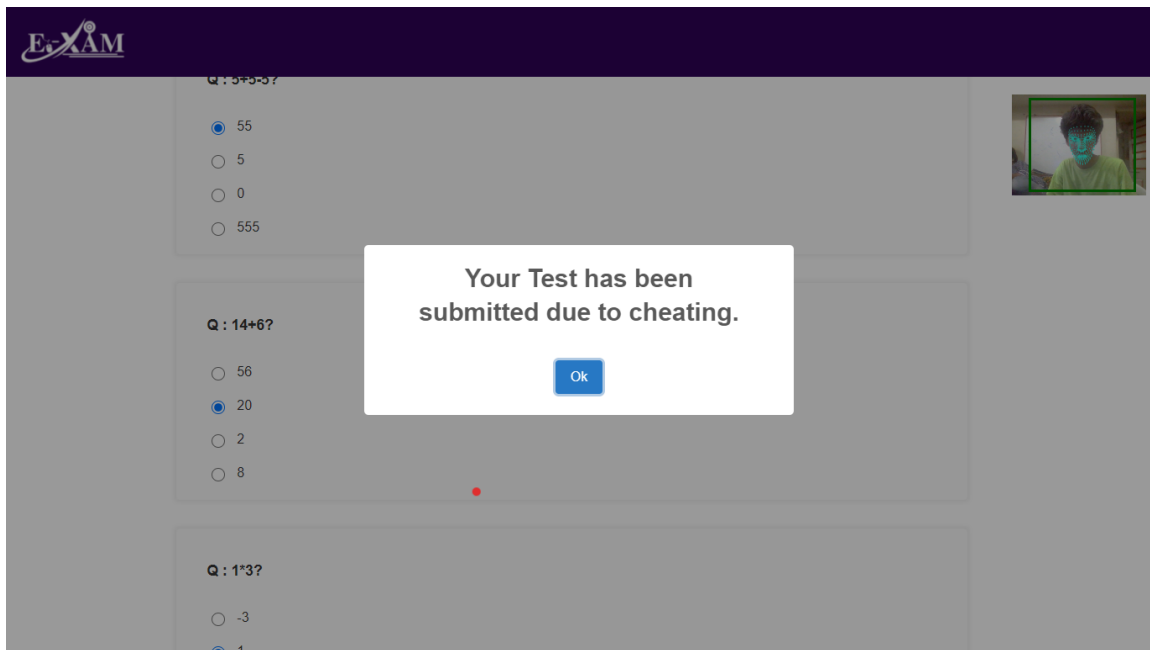**Figure 5.17: Multiple Person Detection**

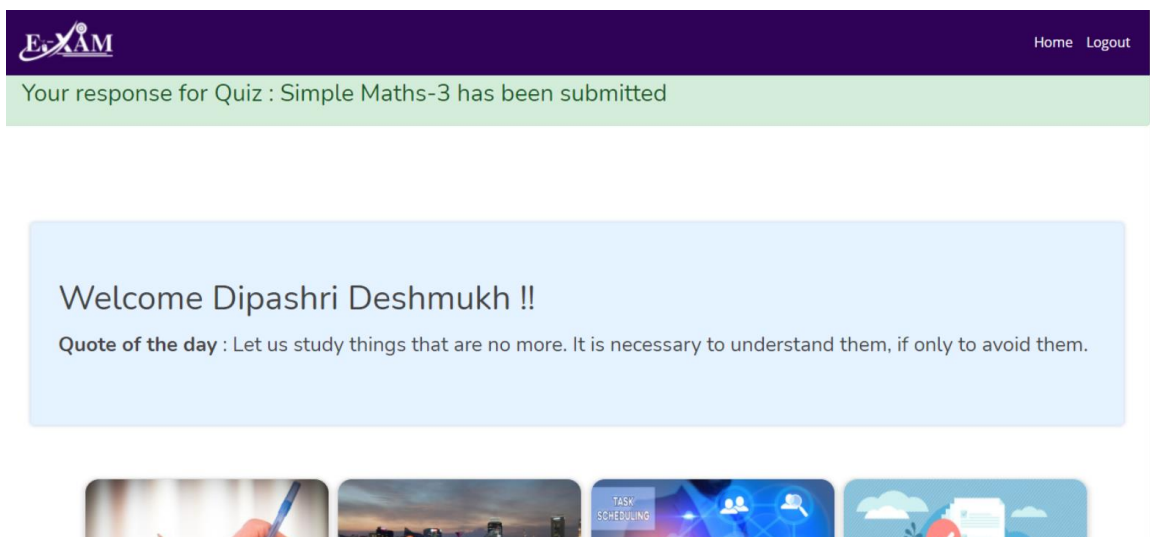**Figure 5.18: Test auto submitted due to cheating**

Figure 5.19: Test submission alert

3) Auto grading module

For objective question tests, the system will give scores immediately when students submit answers. If questions on the paper are subjective, the teachers will send email to students after correcting the answers online. Students also can login in the system to click the scores query button in the navigation bar. The system will jump to the student achievement page. This page shows the students grade of all the subjects, moreover,

students can choose to view the details of each subject. Detailed page includes the scores of all kinds of questions.
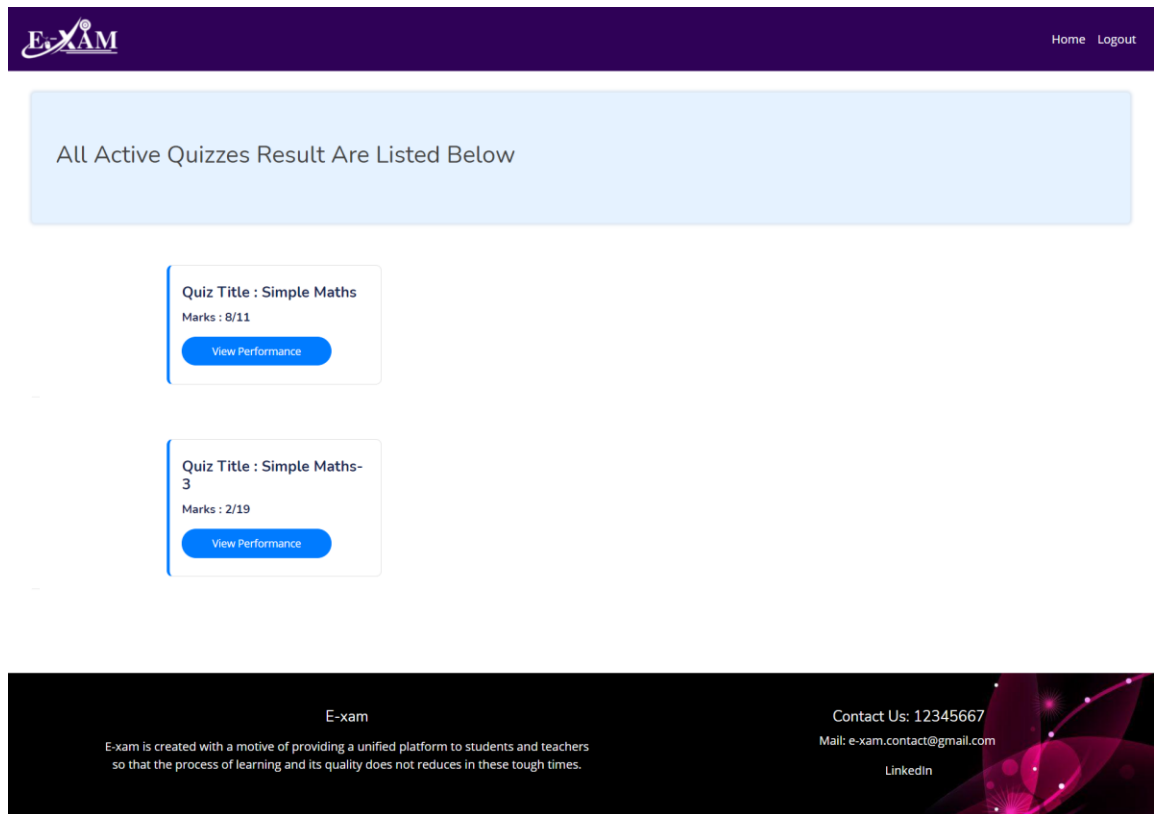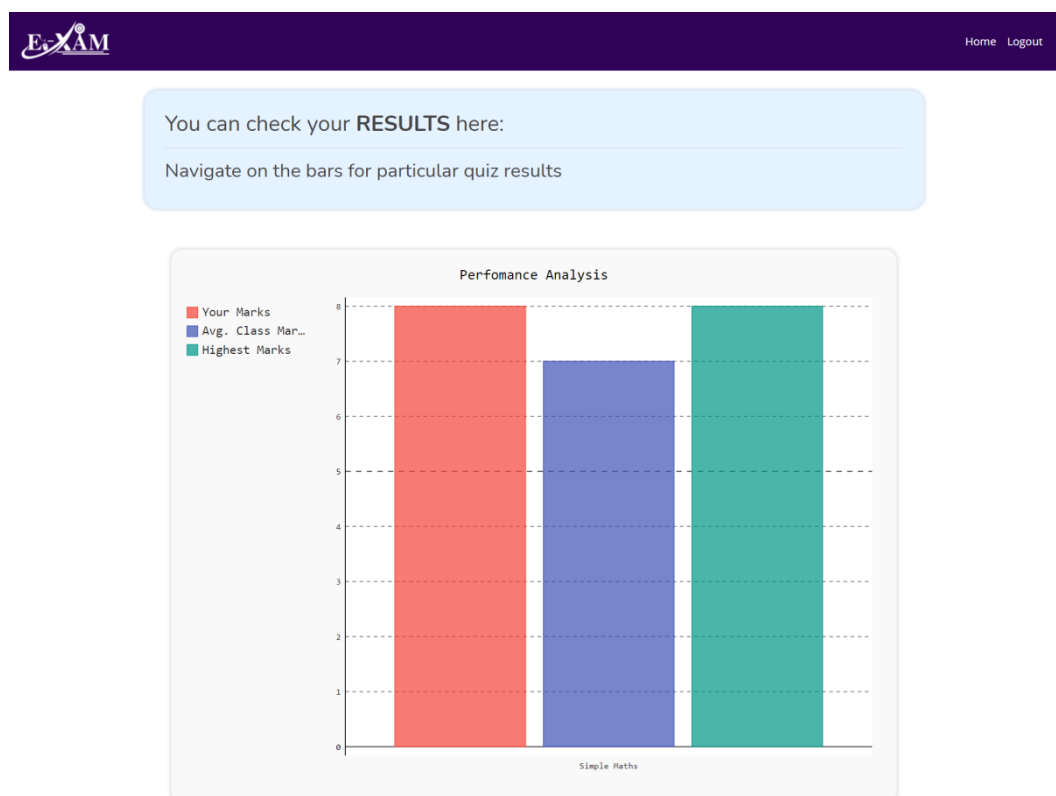

Figure 5.20: View Results

Figure 5.21: Performance Analysis

5.2.3 TEACHER

Functionality 5: Teacher Dashboard

On this dashboard there are three activities which are create test, activate/deactivate quizzes and view performance. In create test, teacher can create quiz/test and set the date whenever they want. After creating a quiz, quiz id will generate and that id they have given to the students through which they can access their quiz. After creating test teacher have to activate that test and further they can deactivate it from activate/deactivate button in dashboard.

Figure 5.22: Create Quiz Module
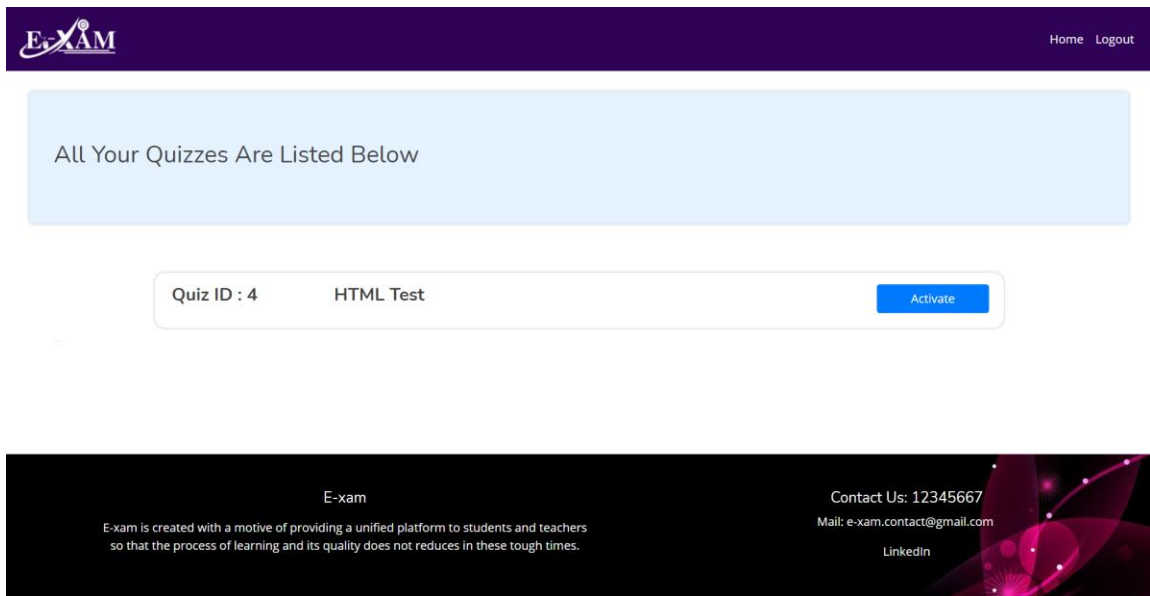
Figure 5.23: Activate/Deactivate Quiz

Functionality 6: Automatic Question Paper Generation

The system randomly organizes questions to make up a test paper automatically. According to their own needs, all the teachers can automatically extract the questions from the item bank to form a test paper by setting the parameters. These parameters are: question types, score of every type, degree of difficulty, and chapters.

Functionality 7: Paper- scoring module

This module is one of the core functions of the online examination system. It includes automatic and manual mode. The automatic mode needs to match the students' correct answers. In the system, the types of objective questions are divided into single topic selection, multiple choice, and judgment questions. According to the characteristics of the different types of questions, the system designs different matching algorithms of the correct answers and quickly calculates the student's test scores. At the end of the exam, the system will automatically give scores for students to look at according to the students' answers. In the manual mode, teachers correct subjective questions online. When the examination is over, teachers score students' answers and record scores into a database.

Functionality 8: Score-analyzing module

This module provides the score of each test about each student, and displays the scores of all kinds of questions. With this module, students can learn about their weaknesses and advantages in detail.

Functionality 8: Score Visualization Module

The system automatically generates statistical results of each exam, including score distribution, total score, and average score, which can help teachers master the study state of all the students. On the basis of these results, teachers can change teaching strategies, and improve teaching methods.
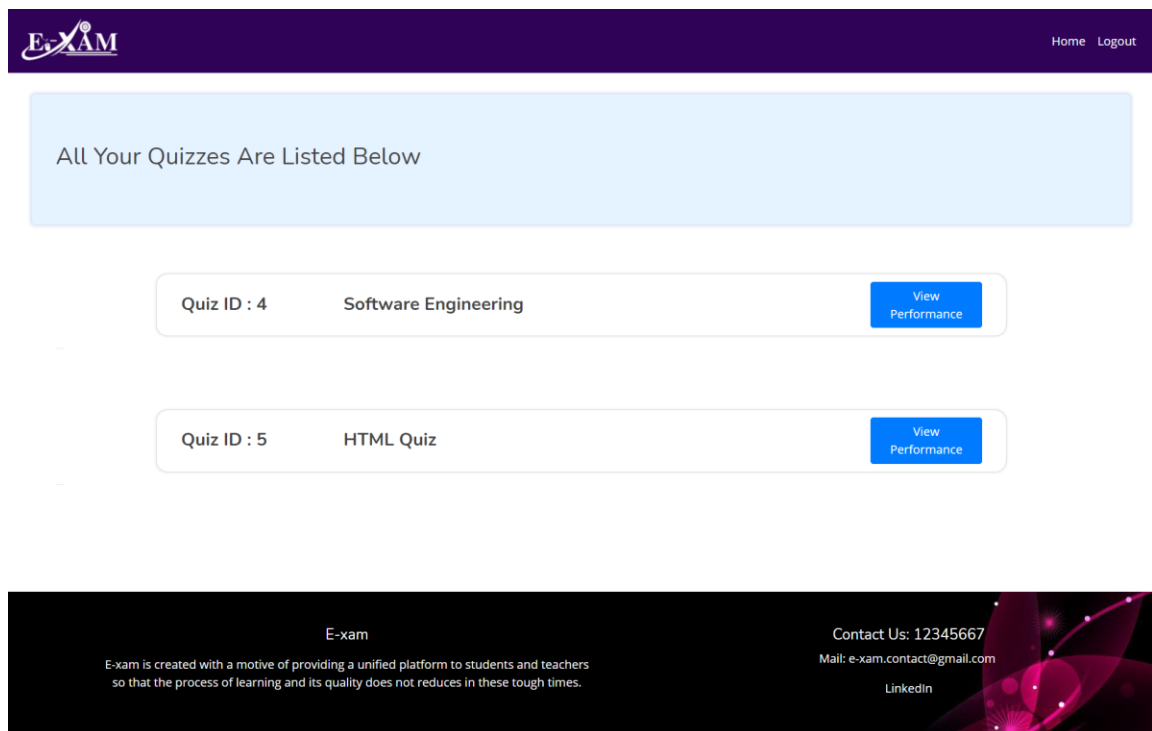

Figure 5.24: View Results Section

Figure 5.25: View Performance Section

Results can be downloaded from the view performance section. The downloaded is in csv form.

Figure 5.26: Downloaded CSV Format

5.3 **SYSTEM TESTING**

The system testing were the final tests that encompassed all aspects of the website. Various functional, non-functional, except unit tests were repeated within each of the system tests. These were the closest tests to how the user will be actually using the website. The only difference that sets these tests apart from the unit tests was that they aren't specifically being tested; the components were expected to work correctly as part of the system.

In system testing, integration testing passed components are taken as input. The goal of integration testing is to detect any irregularity between the units that are integrated together. System testing detects defects within both the integrated units and the whole system. The result of system testing is the observed behavior of a component or a system when it is tested.

- Testing the fully integrated applications including external peripherals in order to check how components interact with one another and with the system as a whole. This is also called the End to End testing scenario.
- Verify thorough testing of every input in the application to check for desired outputs.
- Testing of the user's experience with the application.

That is a very basic description of what is involved in system testing.

5.4 **RESULTS AND ANALYSIS**

Due to Covid-19 Pandemic, Students are unable to give Examination at the Exam Center. It is very risky to take an examination at the Exam Center. To overcome this problem Online Examination using AI Proctoring is the best solution to take Exam. Using AI Proctoring, students can give exams at home without going anywhere. E-Xam is an open platform to all organizations, Colleges, Educational Institutes to conduct exams during a pandemic. Due to AI Proctoring, E-Xam has a lot of functionality to avoid cheating in Examination. By using AI, the E-Xam platform detects various kinds of cheating in examinations. E-Xam System automatically generates student results and due to the AI proctoring system students do not try to cheat and If Students detected it automatically removed from the test.

PLAN OF WORK

6.1 PROJECT MANAGEMENT

6.1.1 CODE AND DOCUMENTATION

Information	Description	Link
Code Storage	Project code will be stored in Git repository	GitHub Repository
Project Documents	Project documents will be stored in Google drive	Google Drive URL

Table 1: Code and Documentation

6.1.2 TEAM

Team Member	Role
Dhanashri Randive	Front-end Development (Dashboards and Home)
Dipashri Deshmukh	Front-end Development (Test Module)
Pushkar Asapure	Database and Backend Development
Sarvesh Chaudhari	Proctoring Module

Table 2: Team and Roles

6.1.3 DELIVERABLES

#	Deliverable	Link
1	Code	https://github.com/typhoon99/E-Xam
2	Demo Video	https://youtu.be/BpL9WPgzAWU
3	Project Report	https://github.com/typhoon99/E-Xam/blob/master/report.pdf
4	Live Demo	https://e-xam-ssvps.herokuapp.com/

Table 3: Deliverables

6.1.4 COMMUNICATION PLAN

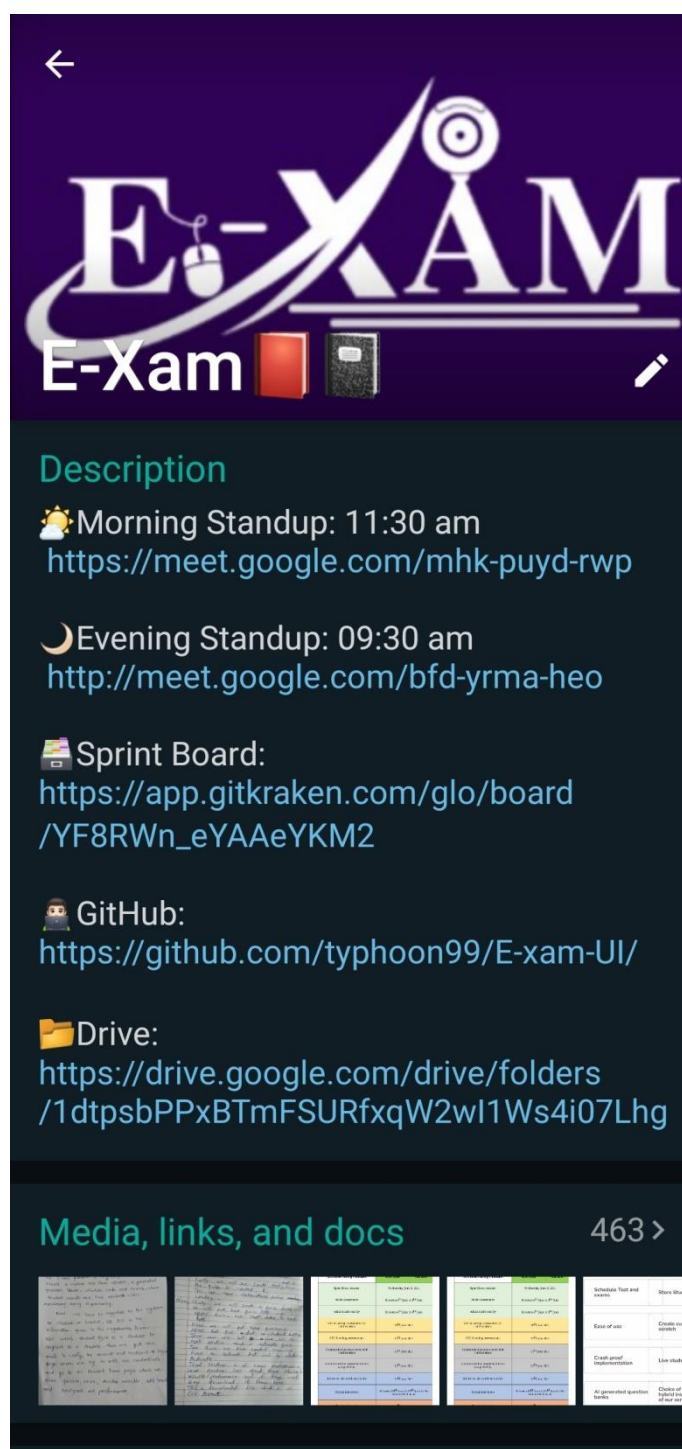| Meeting Type	Frequency	Mode
Daily Standup	Twice a day	Virtual (Google Meet)
Sprint Review Meeting	Weekly (On weekends)	Virtual (Google Meet)
Sprint Retrospective	Bi-weekly (Every fortnight)	Virtual (Google Meet)

Table 4: Communication Plan

Figure 6.1: Communication Medium

6.1.5 SOFTWARE ENGINEERING METHODOLOGY

Model

- **AGILE SCRUM Development**

Tool Used to manage sprints
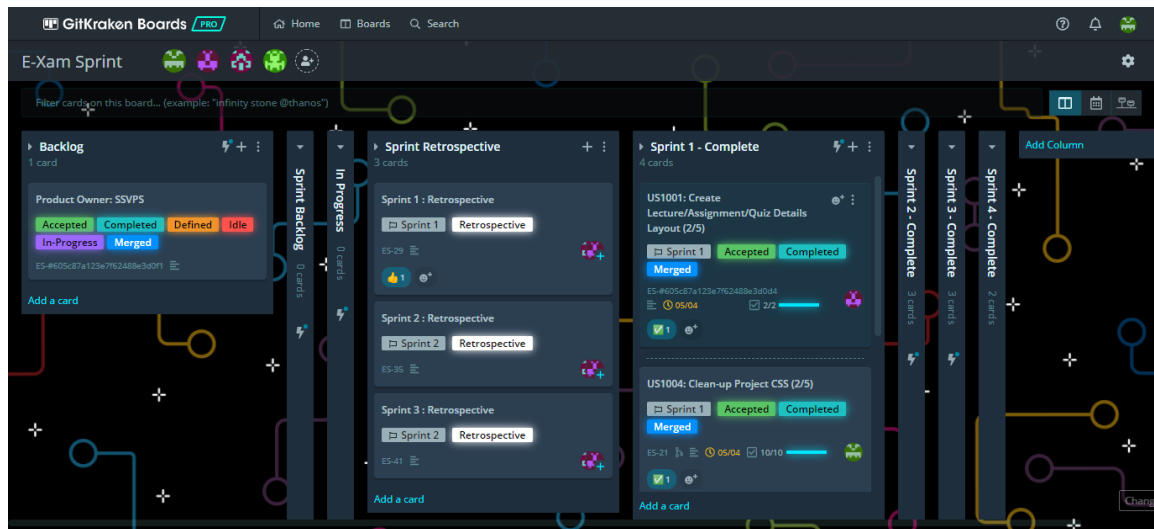
- **GitKraken Glo Board**

Figure 6.2: Sprint Management

Number of Sprints

- **4 bi-weekly sprints**

ADVANTAGES AND DISADVANTAGES

7.1 ADVANTAGES

- **Environment-Friendly**
- **Economical**
- **Quick Turnaround Time**
- **Highly Secure**
- **Easy-to-use**
- **Auto grading**

7.1.1 ENVIRONMENT-FRIENDLY

The traditional pen-and-paper exams have detrimental effects on the environment. Considering the copious waste of paper, efforts must be made to minimize the natural resource usage. In a world where addressing the climate change crisis is our utmost priority, one of the advantages of an online examination system is substantially safeguarding the environment. With technology, it is apparent that nature doesn't have to bear the brunt of human insensitivity any longer. The adverse environmental impact of mercilessly cutting down trees for paper is evident. However, using an online exam system will ensure that institutions and organizations can go paper-free and not print exam papers and create a paper record of applicants, etc.

7.1.2 ECONOMICAL

The administrators experience numerous online exam advantages. When considering the human, logistic and administrative costs associated with the traditional exam setting, it's easy to distinguish an online exam system as the most economical system to conduct exams at scale. There is no need for students to assemble in large, spacious classrooms to take the test. The flexibility of time and venue lend considerable popularity among examinees. Online exams don't require renting a class or hiring an assessor for manual invigilation.

7.1.3 Quick Turnaround Time

The enormity of the task is known to everyone involved in designing, managing and evaluating assessments, from students to teachers. One of the essential benefits of an

online examination system is that it reduces the time invested in overseeing the entire examination process. The exam platform saves precious time for both students and teachers, which would otherwise be wasted on repetitive tasks. The exam software features the option of adding and importing questions, enabling students to access the exam and facilitating batch-wise examinations.

Traditionally, exam distribution demands adequate time for end-to-end management. On the contrary, the benefits of an online examination system have expedited the process. Examiners can merely upload the email ids of the participants and invite them for the assessment; the most notable aspect is the instant generation of the results.

7.1.4 HIGHLY SECURE

One of the main benefits of an online examination system is the enhanced privacy for students, which validates the usefulness of the entire process. There is no room for conducting malicious activities to rig the system and produce incorrect results, indulge in cheating or other such unlawful practices. In such a secure system, students too embrace the results without contesting the outcomes, which encourages positive growth. Such levels of security and privacy foster a more positive mindset toward the educational institution and build a stronger mutual trust among teachers and students, ensuring overall transparency and bias-free results.

7.1.5 EASY TO USE

One of the main advantages of an online examination system is the ease-of-use for the administration and the students. The examiners can easily set up the questionnaire, determine the grading and send invites to students. Meanwhile, students can take exams remotely. Even participants from remote areas can attend the exam. Moreover, there is no scope of question paper leaks as every student gets a randomly selected set of questions as per the arrangement determined by the examiner.

7.1.6 AUTO GRADING

The benefits of an online examination system include setting up an automated grading system, more convenient than a standard grading method. The proliferation of technology in e-learning and the increasing number of participants mandate a flawless scoring mechanism that eases teachers' burden, saves time and ensures fairness. Automated scoring finds the correct answers by comparing the respondents' reply against the model answer. Interestingly, MCQs are extensively used in online tests because they make automatic scoring by a computer easy.

7.2 **DISADVANTAGES**

- **Challenges in Technology Adoption**
- **Infrastructural Barriers**
- **Difficulty in Grading Long-answer Type**

7.2.1 CHALLENGES IN TECHNOLOGY ADOPTION

Implementing a new system may create a minor disruption and require a period of familiarization by the users. Any transition from traditional methodology to the online mode will require some investment from educational institutions to upgrade the systems. However, familiarizing both students and teachers with the transition is the ideal way forward. Such training would educate students and teachers about the new features and benefits of an online examination system.

7.2.2 INFRASTRUCTURAL BARRIERS

One of the major disadvantages of an online examination system surfaces in remote locations where access to electricity, stable internet connection and other basic system requirements are difficult to meet. Such barriers impede online exams. Therefore, while shifting to the online mode, institutions must consider whether all students can appear for the test and what arrangements can be made to ensure the same.

7.2.3 DIFFICULTY IN GRADING LONG-ANSWER TYPE

Even though online examinations have eased the invigilators' job, the problem arises mostly with long answer-type questions. Subjective answers require manual grading, for which examiners need to invest additional time. This is where the modern system overlaps with the traditional one. As technology in the education sector continues to evolve, the grading of subjective answers would become easier.

<div align="right">Chapter 8</div>

CONCLUSION AND FUTURE WORK

8.1 CONCLUSION

To solve the current problem of cheating in online exams, the E-Xam Proctoring System provides a better solution to take exams. E-Xam System provides better features than Google forms or Microsoft Office Forms. The E-Xam System is beneficial to all students and teachers. Due to AI Proctoring, E-Xam has a lot of functionality to avoid cheating in Examination. By using AI, the E-Xam platform detects various kinds of cheating in examinations. Because of AI Proctoring Students not try to cheat in E-Xam.

8.2 FUTURE WORK

The limited time and resources have restricted us to incorporate in this project. We can improve accuracy of machine learning models. Only main activities that can be performed in Exam System are shown in future we will try to make them more user friendly. In future we will try to provide facilities like: Teacher can add subjective questions, Compiler and Coding questions for E-Xam System, added including paper-and-pen to digital exam via OCR, training of better AI models, addition of CI/CD pipelines, support for assignments and fetching test results from other websites.

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