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Proctoring System

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A B S T R A C T

The idea is to provide a framework for students and instructors. The framework provides automated monitoring of candidates giving exams. The system tracks the behaviour of candidates and logs them into a database. The framework is built on a client–server system with HTML, CSS and JavaScript in the front end, and Flask handling the backend. This project would automate the proctoring process which would assist the teaching staff to invigilate better. This system would monitor activities of the candidate on camera and on his/her device. An online proctoring system is an advanced AI integrated system developed to ensure a secure test environment when a test-taker writes an online test remotely. Anti-cheating proctoring tools, proctoring integration with any LMS, and the ability to detect cheating instances with optimum reliability form the crux of an ideal proctoring system.

Keywords:Proctor, Proctoring System.

1 . INTRODUCTION

The 21st century is the digital world, where everything is done through electronics and autonomous devices. In this era where no one wants to do any task which takes more effort and time, they do the same task by digital which makes it effortless as well as time-saving. During COVID-19 pandemic many exams were discontinued. Proctored Objective Online Examination is a case study for providing a solution for conducting online examination instead of manual examination. This will be a web application that allows examinees to conduct the exam for examinees by colleges/universities/organizations. This application will allow your objective type's examinations for professional and non-professional courses.

The first objective is accuracy of program can handle enormous data that is a human coming up with ideas task and is prone to some significant errors that can ruin the result, and one of the advantages is that it can accurately evaluate any amount of information. Every day, the usefulness and implementation of AI increases, and this is why when making important decisions, it can be based on more than individuals.

Next is the test is a way procedure that requires several measures and individuals. Without spending the time and resources of many people, the online examination can be carried out. By decreasing the presence of people to vigilante the students, remote proctoring enhances the operation. This makes it more agile for the test.

Third is efficiency, it is more reliable compared to traditional processes when every process produces. The introduction of AI into online proctoring software helps the administrator to efficiently set objective and consistent tests. By offering a comprehensive overview of individual candidates in real-time situations, also contributes to the purpose of Exam Proctoring.

The adaptive online assessment system, as mentioned before, lets institutions produce the assessments quickly. The assessment and result declaration are also increased by the exam programmer combined with online proctoring. In the case of objective style questions, the device will evaluate the answers instantly and the result can be announced as soon as the student finishes the exam. The assessment can be performed with a few clicks and report the result, even for personal type questions.

2. LITERATURE REVIEW

The current online examination system is good for conducting the online examination, but it has many limitations and issues like platform-dependent, tracking of examinees' activity, preventing and monitoring unfair means activity, affordable hardware, and security issues. So we are trying to solve the problem as we wish to provide a complete platform-independent environment, with secure and well managed remote proctored online examination, where both, institute and examinee will satisfy and comfort to appear in the exam.

Providing a secure, well managed online examination platform is a big challenge for us. We have tried to find and solve such kinds of problems and external activities which act as unfair means by the examinee. There are many challenges which will be faced while appearing or preparing for the online exams.

Existing Research Papers

This paper introduces a new approach for exam proctoring using a 360-degree security camera [5]. Mainly, online exams' security is a major concern. Thus, a delivery tool must not only ensure the identity of a test-taker but also the overall test integrity. In this paper, the usage of the 360-degree security camera over the traditional webcam was investigated in order to enhance the exam security and to minimize the stressful restrictions.

A 360-degree camera is also a very good implementation since it can also monitor things beyond the existing webcam visions. This way, candidates can be monitored better. But a 360-degree camera is not feasible for everyone to buy, hence be a good solution in current times

The DLIB is a library in C++ which has various machine learning algorithms. Two of which are Predictor 5 and Predictor 68. These models help to detect 5 and 68 facial landmarks respectively. Using these landmarks and OpenCV's SOLVEPNP methods, an angle can be estimated of the object surface with respect to the screen. This method was useful in determining head pose, but there was no web implementation in JavaScript, which we needed. The FSA-Net is a neural network that uses regression and feature aggregation. The model is built in TensorFlow and Keras and could be used in JavaScript by converting the model to TensorFlow for JavaScript format and using it.

Media Pipe [3] Face Mesh [4] is a neural network to approximate a 3D mesh representation of a human face from single camera input for AR applications. The relatively dense mesh model of 468 vertices is well-suited for face-based AR effects. This model is helpful for 3D representation of faces and determining the angle of face with respect to the screen. The process is to access the coordinates of certain landmarks and do certain trigonometric calculations to determine head angle.

Media Pipe is a simpler approach which is a ready to use model also available in JavaScript. Media Pipe. Media Pipe detects 468 landmarks on a 3D space, and some trigonometric operation on some of those coordinates will help to determine head pose. Media Pipe is chosen for head pose estimation for its ease of use.

3. PROPOSED SYSTEM

System Architecture

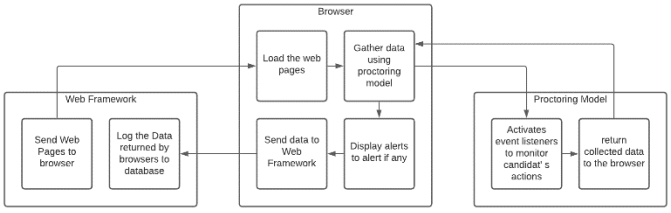

Fig 3.1 System architecture of Proctoring System

Web framework is a software framework that is designed to support the development of web applications including web services, web resources, and web APIs. Web frameworks provide a standard way to build and deploy web applications. Web frameworks aim to automate the overhead associated with common activities performed in web development. Web Framework in this project helps to send web pages to browsers, receiving data sent by web pages and logging that data into the database.

Browser is a software application that loads web pages. Here, it acts as an interface between the user and the proctoring model. The web pages received by the browser are designed to collect data which is the actions like looking away, missing form camera, or shifting tabs. This is basically done by sending the images collected be web page to proctoring model

Proctoring Model is the program that receives images and tells whether the candidate is looking away or not, or the candidate is missing from the camera. This is done by Media Pipe's Face Mesh module to detect head pose and returns this data to the flask server

Flowcharts

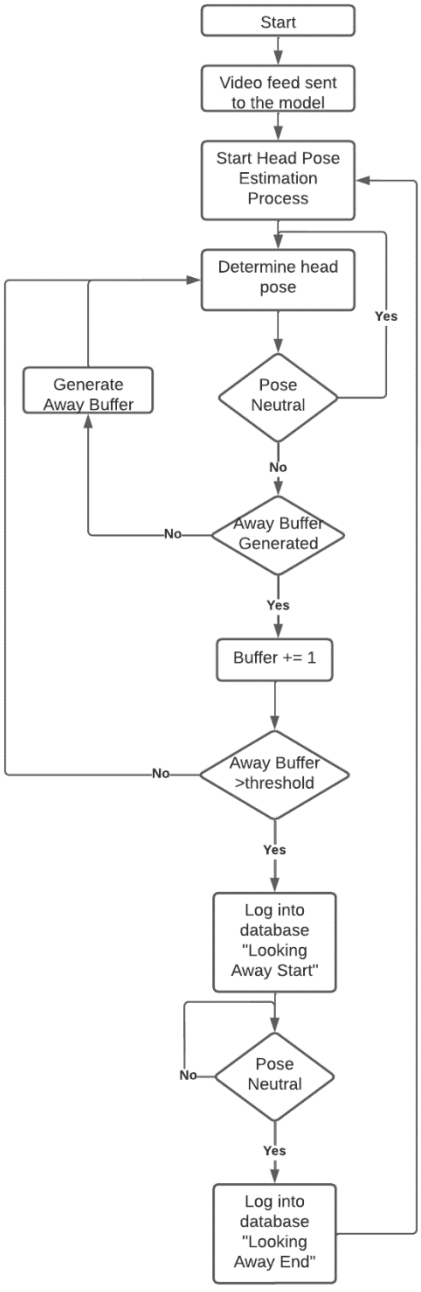

Fig 3.2Flowchart of head pose estimation model.

The System does not directly log in the database once suspicious activity is observed. It generates a buffer of 1000 Ms i.e. it waits for 1 second and then logs into the database. Once candidates' behaviour is normal, it is also logged into the database, with timestamp logging the behaviour and time of each candidate.

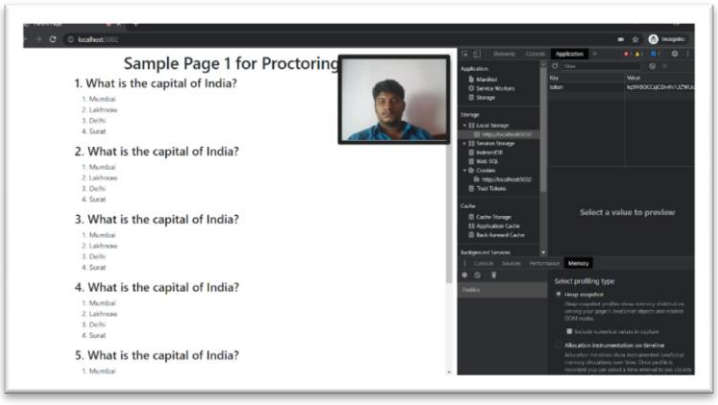

Fig 3.3 Homepage

The image above shows the immediate exam screen after entering roll number. This page has a hovering window that shows the camera feed. A token is stored in the local storage (as seen on the right side of the image) of this website in the browser. Hence this browser cannot be used again for exam due to the token.

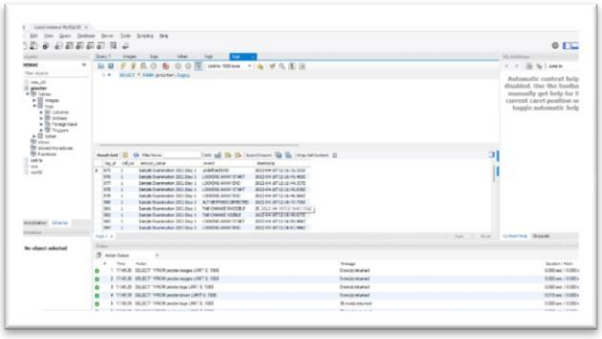

Fig 3.4Data logs

All the data is fetched into the MYSQL database where we store all the actions projected on the camera. These actions include looking away from the screen, being away from the screen, changing tabs, neutral (i.e. not doing anything suspicious) with the timestamp.

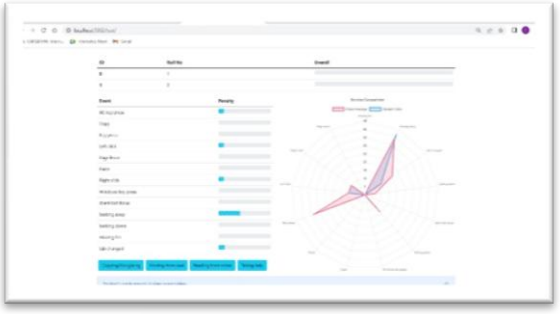

Fig 3.5 Proctor Analysis

This is a web page where all the logs from the MySQL database is fetched and mapped into an informative for analysis of the violations. It shows the frequency of the times someone tried to cheat in the examination and also provides a representation of data in the Spider graph for better understanding.

Flask

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.

In this project, one way to use flask server was to use flask server for prediction. In this, the server would send webpages. When web pages would have test data and would collect the user data that is camera feed and event listeners, and send this data to the server. The server would make predictions on image and log data as necessary. Also return warnings if found to the browser pages so that they would show it to users. The drawback of this process is that it would take a long time to move data up and down from server and webpages now and then. It would also have a lot of data collected and be processed by one device for a lot of students. In short, it would be a very inefficient and slow and cost a lot of processing to the server computer

Instead, what we do is make the predictions at web page level. The predictions are done be the JavaScript part of the front-end. The JS would use Media Pipe model to estimate head pose and send data as required. This would reduce the amount of data send back and forth from web pages to server by a huge factor in comparison to previous method. Next, it would also reduce a lot of loads of processing on the server as every device giving exam would do the processing. Hence in comparison to the previous method, this would be overall efficient and faster.

Browser

A web browser (commonly referred to as a browser) is application software for displaying web pages. When a user requests a web page from a particular website, the web browser retrieves the necessary content from a web server and then displays the page on the user's device. Web browsers commonly include an address bar or search bar, the ability to open multiple web pages in different tabs, and other user interface features for navigating the web. In this project, browsers would load and display web pages sent to them by Flask.

Front-End

The structure of web pages as done via HTML. HTML or Hyper Text Markup Language is a markup language, meaning it is a script that defines the structure of the document to be displayed. HTML decides what are the parts of document or web page and where should they be. An HTML page looks very bland. Without any colour and designs. To add some colours, designs and animations, CSS is used. CSS is Cascading Style Sheets that allows us to design the elements of HTML. The proctoring part in the web page is defined in the JavaScript. JavaScript serves a lot of functions. Firstly, are event listeners which detects keys pressed by the user. The event listeners is an inbuilt function in JavaScript which takes the event to listen for, and a second argument to be called to be called whenever the described event gets fired. Any number of event handlers can be added to a single element without overwriting existing event handler. Next, we load the Media Pipe Face Mesh Model using which we get an estimation of head angle. Lastly, we create a whole procedure as to what is to be done when certain things are detected, e.g., if a candidate looks away from screen, it should alert him/her and log this into the database. So once candidate's login for an exam using their roll number, a unique token is generated by the model and is stored in the local storage of the browser. So now, even if the candidate logs in with another roll number, he/she will not be allowed to appear for the exam since a token is stored on that device.

Media Pipe

Media Pipe is a framework for building multimodal (e.g., video, audio, any time series data), cross platform (i.e., Android, iOS, web, edge devices) applied ML pipelines. With Media Pipe, a perception pipeline can be built as a graph of modular components, including, for instance, inference models (e.g., TensorFlow, Tillite) and media processing functions. Media Pipe offers customizable solutions to certain problems like Face Detection, Face Mesh, Objectron, etc which are easily customisable and in ready to use state. We have used Face Mesh, which is a Face Landmark Detection Model. Face Mesh detects 468 points on the face in X, Y and Z axes, which are relative to image dimensions. Face Mesh Model of Media Pipe helps us to determine the proportional angle of face relative to the screen.

For training, we rely on a globally sourced dataset of around 30K in-the-wild mobile camera photos taken from a wide variety of sensors in changing lighting conditions. During training, we further augment the dataset with standard cropping and image processing primitives, and also a few specialized ones: modelling camera sensor noise and applying a randomized non-linear parametric transformation to the image intensity histogram

Media Pipe has adopted the policy that the x- and y-coordinates of the vertices correspond to the point locations in the 2D plane as given by the image pixel coordinates. The z-coordinates are interpreted as the depth relative to a reference plane passing through the mesh's centre of mass. They are re-scaled so that a fixed aspect ratio is maintained between the span of x-coordinates and the span of z-coordinates, i.e. a face that is scaled to half its size has its depth range (nearest to farthest) scaled down by the same multiplier.

4.Result

Automation is the inevitable need for humanity to prosper. The main objective of automation in today's world is to do all those uncreative tasks that require human cognition for decisioning. This negative side perceived of this argument is that it would render a lot of people unemployed. But the long-term vision suggests that it would release a lot of people doing any uncreative tasks and allow them to do something that really matters more and generates more revenue.This proctoring system is an attempt to automate the invigilation part of tests. We start with browser pages that are an interface for candidates. These browser pages are where the student give exam and our model collects the data on behaviour (images) of each candidate. This data is processed to extract information (looking away from screen, missing the test) and log that into the database.Due to certain constraints, we cannot make

this a full proof system as our model can only work on camera images and cannot see beyond the vision of camera. But still, it will work pretty good on the images it can get.

Proctors	Network Bandwidth recommended (mbps)	Latency per request (ms)	Performance metric in comparison to human audit
ProctorU	3.5	247	86
Respondus	4	563	70
ProctorIO	8	492	75
Ours	2	76	92

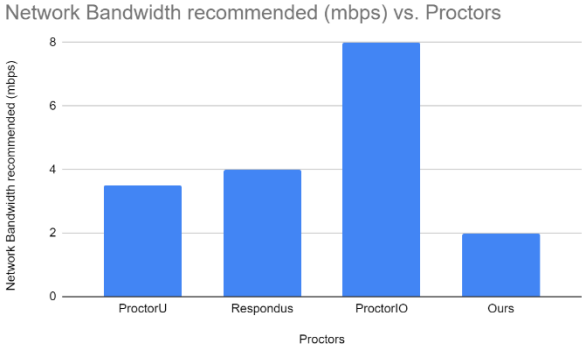

Fig 4.1 Network Bandwidth recommendation

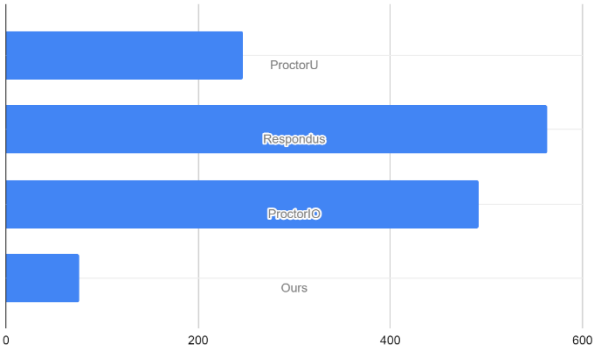

Fig 4.2 Latency Comparison

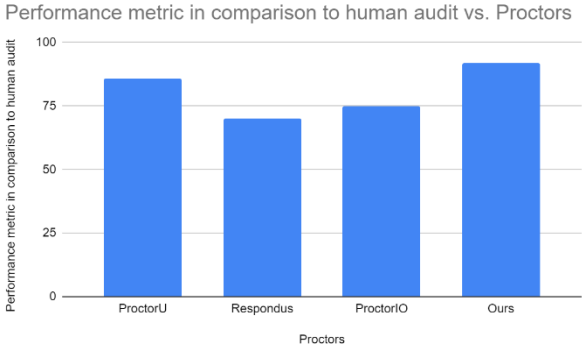

Fig 4.3 Performance metric in comparison to human audit

5.Conclusion

The whole model is managed by Flask. Starting from sending web pages to the client browser. These web pages are an interface for candidates to give their exam and allow the proctoring system to monitor the student behaviour on camera and on browser (changing tabs and keys pressed). The detected

behaviour is recorded in the form of data (Looking Away Start and Looking Away End, Person Missing Start and Person Missing End) and sent to the Flask Server. The received data is logged into the database logging every action the candidate makes.

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