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VISION: A COMPUTER VISION BASED SECURE ASSIGNMENT FRAMEWORK

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Abstract

With the rise in pandemic situations daily, the worldwide education system is at a standstill, and due to this pandemic, authorities had to switch education to a virtual education system. However, people are not very familiar with virtual education and this transfer led to many considerable concerns. Since the online education system is a new concept for students and teachers, it is important to find a method where teachers can substantiate the authenticity of the student's work. This paper introduces a computer vision based secure assignment system framework. A distinctive secure and efficient login system is pioneered, which involves an efficient face recognition mechanism aided with a critical blink detection system to ensure the student's liveliness and prevent image spoofing during any examination. A unique two-level way is designed to inform the concerned instructor about plagiarism in the student's work.

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1. Introduction

The outbreak of COVID-19 (SARS-COV-2) has swept the globe. This emerging situation after the COVID-19 pandemic has resulted in numerous adjustments in various life sectors, including industry and commerce, transportation, and education. However, the education structure is the most adversely impacted, as there is an abrupt shift to the online mode, which is still a new and growing field. This learning approach is still in a growing phase, and it was primarily conceived to facilitate distance learning. According to several types of research, e-learning has become the latest expansion in higher education due to the numerous scholastic advantages it can deliver [1]. Online systems have resulted in a shift in modern student's studying habits and a transformation in the way student's views learning now [2]. However, the fact cannot be ignored that institutions have difficulty conducting fair evaluations of student performance due to the change in the educational environment from offline to online services. Several computer vision and NLP related works are successfully implemented to recognize the objects [3-7].

The designed and proposed framework provides an end-to-end solution for a trouble-free and secure working of the education system's evaluation module. The proposed system focused on the authenticity of the student work and ensuring student's presence during any examination or task. The framework also ensures that only the plagiarized work does not go through the system undetected. A prototype user-friendly GUI implementation of the framework is also described.

The rest of the paper is divided into four sections. In the 2nd Section, work and techniques done in the past are mentioned. Then in section 3, a proposed methodology of the problem and the solution's workflow is presented. Following that, in Section 4, the further advancement that will be made in the future are marked.

2. Related Work

2.1 Facial Features Detection

Turk and Pentland, 1991 [8] created a facial recognition system based on

the Eigen faces technique. This was a game-changer for face recognition technology. This provided the foundation of the Face Recognition Algorithm. Idea behind Eigen Faces can be described mathematically in Equation 1, where F is new frontal face; F_m is avg frontal; F_i represents Eigen Face and finally α_i define scaler multipliers (+ve or -ve) to create new faces.

$$F = F_m + \sum_{i=1}^{n} \alpha_i F_i \tag{1}$$

Haar Cascade is a machine learning algorithm for object detection whose roots can be traced back to 2001 by Viola and Jones [9]. The Haar Cascade classifier divides pixels in a picture into squares based on features using the Haar Wavelet technique. Feature extraction concept is shown in Equation 2 in which difference of sum of low $\sum S(Black)$ and high $\sum S(White)$ intensity pixels form the single value haar like feature $f(H)$.

$$f(H) = \sum S(White) - \sum S(White) \tag{2}$$

Haar-Features well detect edges and lines which tends to make it very excellent at facial detection. In the proposed framework, the utilization of the Haar cascade is done to implement a face recognition system. The notion of Haar cascade for the integral image is a stepwise procedure for a fast as well as precise calculation for the total of intensity values in the subset of an image which is rectangular in shape as defined in Equation 3. In the equation $i(x, y)$ is the intensity of a grayscale image at (x, y).

$$ii(x, y) = \sum_{x^j \le x,\, y^j \le y} i(x^j, y^j) \tag{3}$$

Face spoofing is a form of assault that involves putting on a false face in front of a camera [10]. The proposed framework addresses this issue by implementing a Blink Recognition system on top of face recognition.

2.2 Natural Language Processing Applications

Plagiarism is a severe problem in academia and has been the topic of several scholarly publications for some years. As recent advances indicate, plagiarism detection is becoming essential, making it easy for a plagiarist to

identify a suitable text fragment to copy. Speech recognition systems operate in tandem with word processing applications to enable users to create written content on a computer using only their voices. Picheny et al. [10] conducted a study to examine the current state of the art in speech recognition and specific strategies that have the potential to achieve breakthroughs in performance. Both these NLP based applications are used in the proposed system.

3. Proposed Methodology

A GUI desktop framework is developed to map the proposed method. The proposed framework is implemented in the python programming language. Python libraries such as Open CV, Tkinter, Speech Recognition, and NLTK are extensively used to aid the development of various components. SQL database is used to appease the storage needs of the framework. Acceptable use of pop-up messages, information alerts, success notifications, and so., keeps the portal user-friendly and interactive. These graphical elements are occasionally augmented with noises or visual effects such as transparency and drop shadows to enhance the user experience further.

The database tables are primarily concerned with Student Information, Teacher Information, Class Data, and Assignments. New columns will be added to class tables, along with new assignments in real-time to aid memory conservation. The framework database is further integrated with the institution's student and teacher database to provide a fail-safe system that will allow the concerned learners and educators registration only through official email IDs found in the institutional database. The framework will already consist of necessary details of the users due to the integration with the institution database. This method of registration is much more efficient and secure than a regular expression-based email system, as, in the regex-based system, it is not easy to cover up all the corner cases. The registration component will recognize and save the facial features by capturing 15 images of the face after minor intervals of time. The operational workflow architecture of the proposed framework is defined in Figure 1.

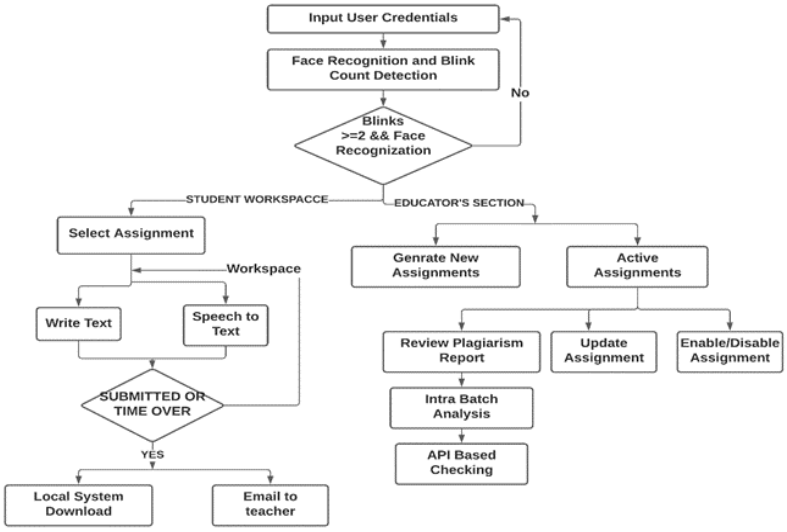


Figure 1. Proposed Framework Architecture.

3.1 Login System. The Login system (Figure 2) involves a two-step authentication, the student first needs to enter the registered email and password. Further, the student will go through face recognition and blink count detection. An image database directory search is initiated based on the roll number to find the dataset of the facial features stored during the registration process. This methodology reduces the search space and time as the data is saved based on the roll numbers. This methodology enables us to keep the searching time complexity to O (1), even if the number of registered users increases to a large extent. Along with detecting facial features, the system simultaneously keeps on counting the Number of Blinks. If the number of blinks is less than the Threshold Value, the system will not let the user log in.

The blink detection system is implemented based on the methodology described by Soukupová and Cech et al. [11]. Each eye is represented by six (x, y)-coordinates. Coordinates are related to one another in terms of their widths. Further, the eye aspect ratio equation is developed to describe the connection. Equation 4 illustrates the eye aspect ratio formula, where e1-e6 denotes the positions of two-dimensional landmarks. The e2, e3, e5, and e6 are used to determine the subject's height, while the e1 and e4 are utilized to determine the eye width in meters [12].

$$EAR = \frac{(|e2 - e6| + |e3 - e5|)}{(2|e11 - e4|)} \tag{4}$$

The EAR threshold value in the proposed framework is set to 0.25. If the EAR value drops below 0.25 and then again moves up in the next frame, a blink is recognized. Implementation of blink and face recognition is shown in Figure 2. This system will help ensure real-time liveness detection and help us stop photograph spoofing due to simultaneous blink detection and constant searching time complexity. The identical login component is also used for the teacher's portal. The Face Recognition system and the Blink Count System are built using the OpenCV.

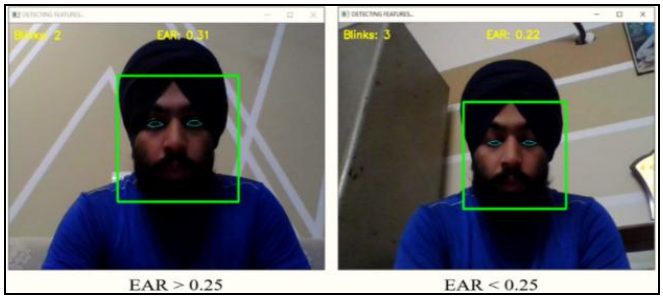
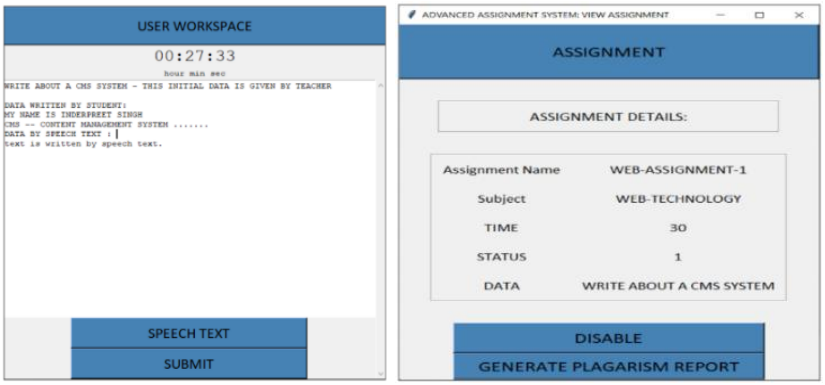


Figure 2. Face and Blink Detection in the Login System.

3.2 Advanced Student Workspace. The student portal is provided in a simple, user-friendly GUI to have no complexity accessing the data. The portal will consist of a list of the assignments assigned by the teachers to the students. The portal flashes the assignment name, subject name, and the time assigned for the task completion. A prototype implementation of the workspace is defined in Figure 3(a). The workspace will be strictly active for the time assigned by the instructor for certain assignments. The workspace will automatically be closed after the time defined. It will pre-contain information provided by the instructor for the task. This information will help the student to understand the task better. The information can also be the question paper for the examinations. The exit button in the framework is disabled so that the user is not able to close the assignment before time. The only way the user can finish the way is through the 'SUBMIT' button. This will ensure that no data is lost, and the student can be saved without any discrepancy.

Some students may have less typing speed than other students, and thus such students are at a loss during online assignments as they require more time to type the answer. To prevent this, the framework has the option of Speech to Text. The Google Speech Recognition API is used to apply the Speech Recognition model. This API transforms spoken text (from a microphone) into written text (Python strings). The system automatically closes when the user utters the word "QUIT". The submitted assignments are directly emailed to the concerned teacher along with storage in the database. Also, a copy of the conducted task will be automatically downloaded in the local directory of the student for their reference.



(a) Student's Workspace (b) Educator's Assignment Panel

Figure 3. Prototype GUI models of the Proposed Framework.

3.3 Educator's Section. Teachers are also provided with a straightforward and effective graphical user interface. To keep the teacher's section legitimate, the registration and login procedure for the teachers is also the same as the students. The primary screen displays the list of all previous assignments formed by the teachers, along with an option to edit them.

A dedicated GUI is developed to form the assignments easily and efficiently. Teachers will have the authority to enable and disable assignments at any point in time; it will help to ensure that all the learners are performing the work at the equivalent time. Any learner will not accept a disabled assignment. This component will allow the educators to conduct physical classroom-like examinations. It will also compel students to do their

tasks in the precise time allocated. The dedicated prototype GUI for the assignment panel is shown in figure 3(b).

A special two-level plagiarism report would be generated for each assignment. An initial report is generated by comparing the transcript of learners. If any sequence of up to three words is realized to be the equivalent, then the sentence will be considered plagiarized. The report will mention all the braces of students who have their assignments plagiarized more than a threshold percentage. The threshold value for the proposed framework is 50 percent. The transcripts which are not found plagiarized in the intra-students check procedure undergo an internet-based plagiarism check. The transcripts are checked for plagiarism using an API-based plagiarism checker from internet sources. Such a system to check the plagiarism helps to reduce the number of API calls to the external plagiarism checker. Thus, the proposed methodology is much more efficient and cost-effective than general plagiarism checking mechanisms. Finally, a complete report of the procedure is generated for the instructor. The Plagiarism detection workflow is defined in Figure 4.

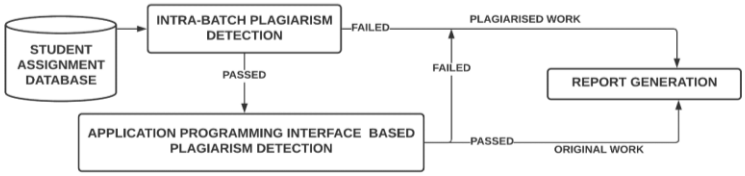


Figure 4. Plagiarism Report Generation Procedure.

4. Future work

While the purposed framework contains several features, there is always growth potential. A component for real-time monitoring can be integrated into the student's workplace to enhance its authenticity and security. Additionally, the system will capture pictures of the individual and compare them to the user's logged-in data. If the user data is not matched, the system will instantly terminate the examination. This type of continuous monitoring may avert any possibility of hacking.

5. Conclusion

This paper proposes and discusses a computer vision-based secure assignment framework. With the help of an efficient login system involving face and blink detection, the framework provides an authentic way to validate the user and prevent image spoofing. The framework involves a unique two-level plagiarism check on the student's work to ensure originality and identify the delinquent. Also, the system implements the real-time mailing technique to preserve the student's work and notify the educators. The framework intends to help develop a smooth online education system for the institutions.

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