Analysis of Students' Focus Levels in Online and Offline Learning Environments

Latha K
Department of CSE

M S Ramaiah Institute of Technology
Bangalore
lekhanakram1664@gmail.com

Parkavi.A
Department of CSE

M S Ramaiah Institute of Technology Bangalore
parkavi.a@msrit.edu

***Abstract*— The proposed model employs advanced facial recognition technology and machine learning algorithms to assess students' focus levels during the learning process. By analyzing facial expressions such as happiness, neutrality, surprise, sadness, fear, disgust, and anger, the model aims to infer students' understanding of lessons in offline and online settings. Training on a diverse dataset ensures its accuracy and applicability. The study's goal is to enhance teaching and learning outcomes by providing valuable insights to teachers in offline classrooms, identifying students who need additional support. In online settings, educators can gauge students' engagement and implement strategies to improve focus and learning experiences. This research bridges the gap between offline and online education, revolutionizing personalized learning and promoting student success.**

Keywords—FocusLevels, FacialRecognition, Learning

Environments, Analysis.

I.INTRODUCTION

Optimizing student focus and engagement is crucial in creating effective teaching and learning environments. Educators' ability to assess students' level of focus during the learning process offers valuable insights for adapting instructional strategies and addressing individual learning needs.

Analysing student focus has far-reaching implications for instructional design, educational psychology, and personalized learning experiences. Identifying students who may struggle to concentrate or engage in online classes allows for timely interventions, support, or adaptive learning strategies. Moreover, focus level analysis aids in evaluating the effectiveness of various instructional approaches and pinpointing areas for improvement.

This project aims to contribute to education by developing a model for analysing student focus levels in both offline and online learning environments. Utilizing facial recognition technology and machine learning, the study seeks to interpret students' facial expressions as indicators of their focus during learning. The findings will empower educators to design more engaging and effective instructional strategies tailored to individual student needs.

In essence, analysing students' focus levels represents a vital area of research and development. By leveraging technology and understanding the connections between facial expressions and student engagement, educators can create impactful learning experiences, be it in traditional offline classrooms or the evolving landscape of online education.

In conclusion, studying students' focus levels in learning environments represents a vital area of research and development. Embracing technology and understanding the link between facial expressions and engagement enable educators to foster impactful learning experiences, regardless of traditional classrooms or the evolving world of online education.

II.PROBLEM STATMENT

The goal of this project is to develop an end-to-end students' focus levels tracking framework that achieves a balance between accuracy and efficiency, making it applicable in real-time applications on a large scale. The framework aims to address the challenge of analyzing students' focus levels in both offline and online learning environments, leveraging facial recognition techniques, specifically using these two algorithms Haar cascade and LBPH Face Recognizer.

III.LITERATURE SURVEY

Human proctoring involves visually monitoring examinees throughout exams is an essential part of assessing the academic process, so it is difficult for teachers to monitor every student at parallelly, so camera overcome that this model came into picture. Here, using 5 actions of student cheating. Use of cellular device, Exchange exam paper, looking at another student's exam paper, using cheats sheet and not cheating. Some of the features to classify the above actions which are: BRISK, HOG, MSER, SURF and SURF & HOG. Using BRISK they are identifying the use of cellular device, Exchange exam paper will be done using the HOG, using MSER feature can detect if a student is looking into the others paper. If they are using cheat sheets will be found using the surf location of interest and using surf detectors and HOG descriptors, Can be seen the no cheating. The cheating recognition model correctly recognized the cheating actions with an accuracy of 91% [1].

E-learning will give the flexibility to the everyone to do their work from anywhere anytime, since face to face communication is not there in the e-learning, its tuff to monitor student's concentrations. In this paper, author has given the solution to find the concentration level in the real time and they have designed it as highly concentrated, nominally concentrated and not at all concentrated. Here, they will take data from the learning environment, then they will detect the face using the face detector, if its human's face then it will go to next step. The data which is taken it will be resized, the data augmentation will happen. Using vgg16 and vgg19 from facial emotions student concentration level [2].

In the education field everything is happening online, for the same student's learning rate is decreased, so overcome that, this methodology has come to picture. In the 1st of framework, the student's video data recorded by a webcam is pre- processed. The pre- processed data are labelled by the two states based on the participants self- reported intent. The data of labelled are used for training the CLRN in the recognition step. The CLRN is devised with supervised learning for binary classification, and the data are prepared with a binary class (0 or 1). The image will be taken, the image has some marks saying nose as 0, eyes are 1 and respectively, ears are 3 and 4, hands are 9 and 8. Then they will be pre-processing it, using CLRN the recognition will be done, then they will estimate part. The KF (Kalman filter) used for filtering, in the estimation step, it will estimate the concentration level. They have achieved the 90% on this method [3].

The student-centered learning is unique because the teacher is not centered. The methods of student- centered learning ranged from jigsaw, choice boards, inquiry based, personalized learning. Choice boards: in this method, the student can choose the study material, activities etc from his own, teacher won't be centred here. Stations or centres or jigsaw: if the students involve in the puzzles along with the studies, he will remember it for longer period. Inquiry-Based Learning: in this learning strategy, learner's queries ideas and analysis are stressed and fostered, focusing on the student perspective regarding a particular open question or problem. Project based learning and problem-based learning: This method depends heavily on student collaboration, communication, and creativity [4].

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Students' actual learning engagement in class, which we call learning attention, is a major indicator used to measure learning outcomes. Obtaining and analysing students' attention accurately in offline classes is important empirical research that can improve teachers' teaching methods. This paper proposes a method to obtain and measure students' attention in class by applying a variety of deep- learning models and initiatively divides a whole class into a series of time durations, which are categorized into four states: lecturing, interaction, practice, and transcription. After video and audio information is taken with Internet of Things (IoT) technology in class, Retina face and the Vision Transformer (VIT) model is used to detect faces and extract students' head- pose parameters. Automatic speech recognition (ASR) models are used to divide a class into a series of four states. Combining the class- state sequence and each student's head- pose parameters, the learning attention of each student can be accurately calculated. Finally, individual and statistical learning attention analyses are conducted that can help teachers to improve their teaching methods. This shows potential application value and can be deployed in schools and applied in different smart education programs [6].

Understanding students' attention span important to understand and enhance the dynamics of a lecture. The main goal of this project is to create an application which will provide information to both teachers and students. The engagement of student in such matters can lead us to desirable academic outcome such as critical thinking, and grades obtained in the subject. Features and Pose Extraction: One immediate feature that comes to mind is eye tracking, but eye tracking tends to suffer from low resolution images. Hence, they use head position which tends to contribute highly in the overall gaze direction. Although head position already is highly accurate in attention detection, paired with another technique vastly improves the results. Students that are paying attention normally react to stimulus the same way that is students having their motions synchronized to the majority are paying attention [7].

In e-learning has increased rapidly owing to the lockdowns Imposed by COVID-19. A major disadvantage of e-learning is the difficulty in maintaining because of the limited interaction between teachers and students. The objective of this to develop a methodology to predict e-learners' Concentration by applying recurrent neural network (RNN) models to eye gaze and facial Landmark data extracted from e-learners' video data. One hundred eighty-four video Data of ninety-two e-learners were obtained, and their frame data were extracted Using the open face2.0 toolkit. Recurrent neural networks, long short- term memory, and gated recurrent units were utilized to predict the concentration of e-learners. A set of comparative experiments was conducted. The main result of this paper is to Present a methodology to predict e-learners' concentration in a natural e-learning Environment [8].

Tracking the concentration of students during online learning offers great benefits. For examples, distracted students can be suggested to do a brief exercise to refresh their brains; or a teacher can be notified when too many students have difficulties on concentration so the class could take a short break. Traditionally, mental states like concentration levels can be analysed using Electroencephalogram (EEG) or Functional Near- Infrared Spectroscopy. However, methods that utilize these data require specialized equipment which is not feasible to deploy on a large scale. And on an other hand recent breakthroughs in deep learning provide possibilities of scalable solutions to detect concentration levels using only webcam. Leveraging this advancement, Authors investigate the task of tracking students' concentration levels during online learning using facial data coupled with deep learning-based computer vision technologies. More specifically, they examine the performances of different representations of facial data integrated with various deep architectures to empirically determine a solution balanced between prediction accuracy and time efficiency that is suitable for real-time application. This paper experimental study shows that the proposed solution achieves over 91% accuracy while keeping execution time low enough for real-time deployment. In this paper, Author selects the three representations for facial data: reshaped videos, landmarks, and embedding vectors [9].

Online learning has become popular across all the countries in recent years due to its flexibility, availability, and accessibility, this model focuses on measuring the student's concentration level by continuously monitoring head pose rotation, eye centre direction and eye aspect ratio (EAR) based on recorded videos watching the learning material. Here, Haar Cascade classifier is used detect face and OpenCV for the facial landmarks. In the 1st step video will be taken from an user and the face will be detected, after that it will search for face land marks which are eyes, nose and ears etc, the head pose estimation is made. Then eye detection and eye aspect ratio, it leads to a threshold model where concentration level and sleeping detection is done. Based on the data it will instruct the computer. From this system, they have achieved the 80% accuracy [10].

IV.SYSTEM ARCHITECTURE

The System Design aims to provide a thorough overview of the architecture of the system. The below diagram contains basic structure of flow between camera and the students.

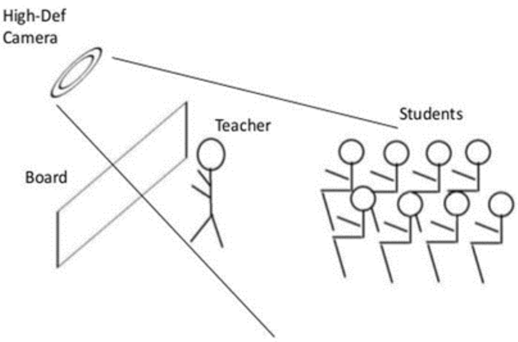

Fig.1 Basic structure for of Learning Environments.

In Fig1.Basic structure for of Learning Environment, the Camera is responsible for monitoring students' focus levels in the Learning Environments.

V. IMPLEMENTATION

1. Flow Diagram of the system:

In the Fig.2, the actors involved are the Head of the Department (HOD), students and professors. The HOD is responsible for monitoring attendance, generating attendance reports and receives focus levels of students. The students interact with the image data management system to provide their facial data for recognition during attendance. The professors are responsible for taking attendance and generating attendance reports.

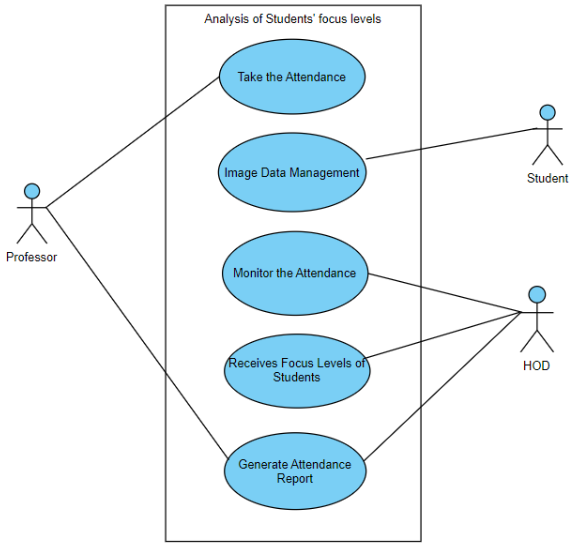

Fig 2. Use case diagram of System.

2. HIGH LEVEL DESIGN

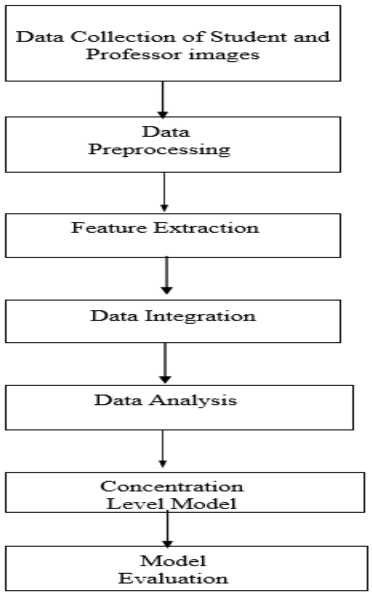

Fig 3: High-Level Design Students' Focus Levels.

1. Data Collection:
   - Gather data on students' performance, engagement, and behavior in both online and offline learning environments.
   - Collect relevant information about the students, such as student's id, name, phone number, email id, semester, course, and subject.
2. Data Preprocessing:
   - Clean and preprocess the collected data.
   - Transform the data into a suitable format for analysis.
3. Feature Extraction:

- Identify relevant features that may impact students' focus levels, such as time spent studying, participation rate, interactions with the learning platform, etc.
- Extract these features from the preprocessed data.

4. Data Integration:

- learning modes to create a comprehensive dataset for analysis.

5. Data Analysis:

- Apply statistical analysis and data visualization techniques to explore patterns, trends and correlations in the data.

6. Concentration Level Model:

- Develop a model to predict students' concentration levels based on the extracted features.
- Consider using machine learning algorithms or statistical methods to build the model.

7. Model Evaluation:

- Assess the performance of the concentration level model using appropriate evaluation metrics.

3. HIGH LEVEL DESIGN

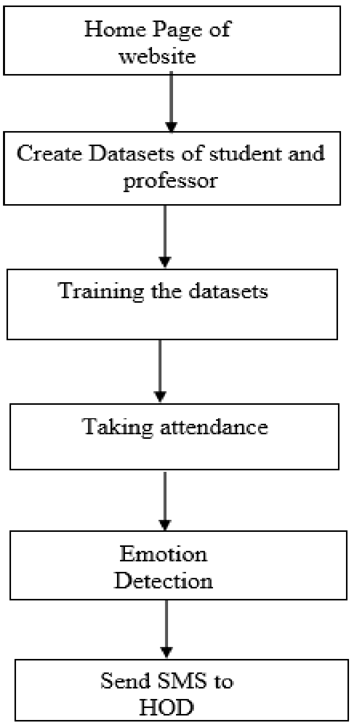

Fig 4: Low-Level Design Students' Focus Levels.

1.Home Page

- When a user visits the home page, the web server responds with the "Home Template" that contains the user interface for the home page.

2.Create Datasets

- When the user submits the form on the "Create Datasets Page" with their information (ID, Name, Phone, Email, etc.), the data is sent to the server using a POST request.

- The server receives the data, saves the captured face images to the dataset folder, and updates the student or HOD details in the CSV file.

- The server responds by rendering the "Home Template" with a success message, indicating that the images and details are saved.

3.Training the datasets

- When the user clicks on the "Start Training" button after creating datasets, the server processes the captured face images and trains a facial recognition model.

- The trained model is then saved in a YAML file for future use.

- The server responds by rendering the "Home Template" with a success message, indicating that the datasets are successfully trained.

4.Taking attendance

- After rendering the "Attendance" page, the server starts capturing the video stream from the webcam and performs facial recognition on each frame.

- The server records the attendance data, including student name, date, time, and emotions detected.

- The attendance information is saved in CSV files for both students, with separate folders for each subject or class.

- Emotion Detection

- The server identifies students' faces using the previously trained student model.

6. Send SMS

- The server sends SMS notifications to inform HODs about absent students and their emotions.

4. FLOWCHART

Overall view of the project in terms of implementation:

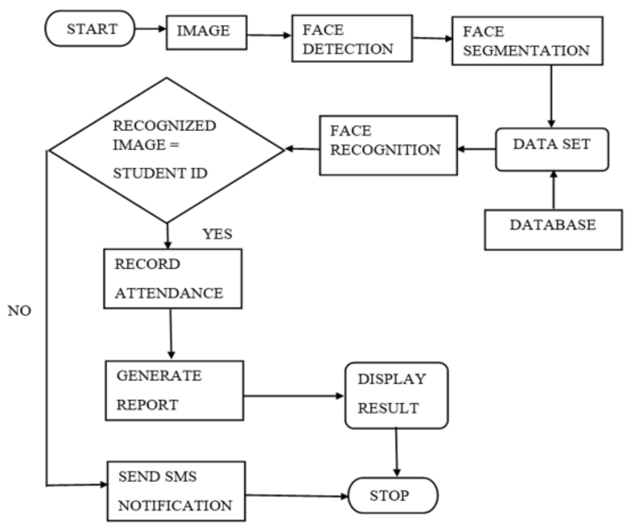

Fig 5: Flowchart.

VI. RESULTS

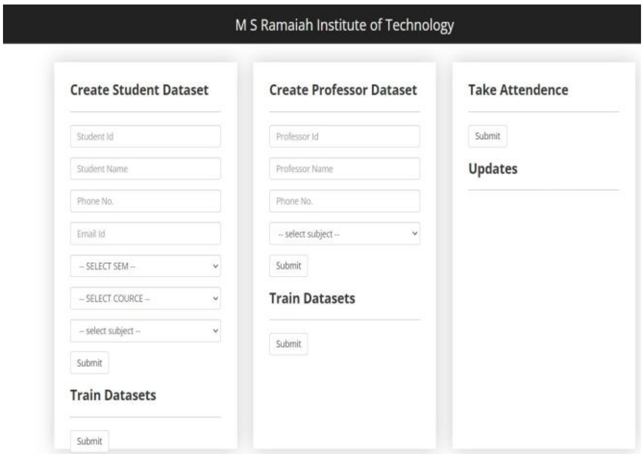

Figure 6: User dashboard.

The Figure 7.6 contains options for students and professors to input their details and includes an "Update Attendance" button.

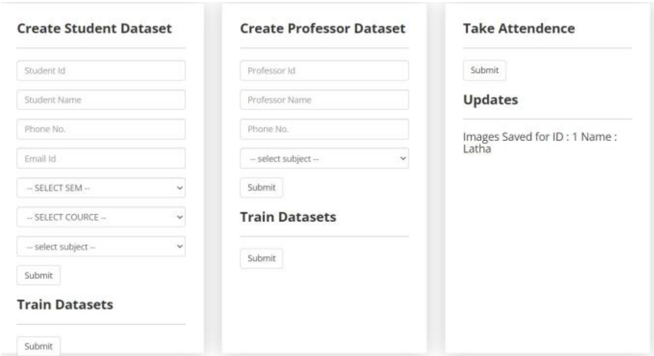

Figure 7: Creating Student's dataset.

The Figure 7.7 generates a student dataset that will be used for training the model.

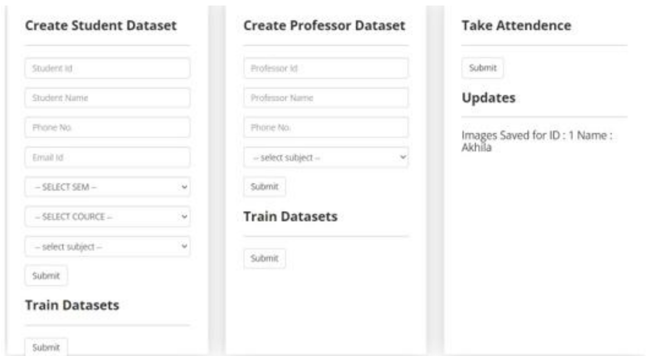

Fig 8: Creating Professor's dataset.

The Figure 7.8 generates a Professor's dataset that will be used for training the model

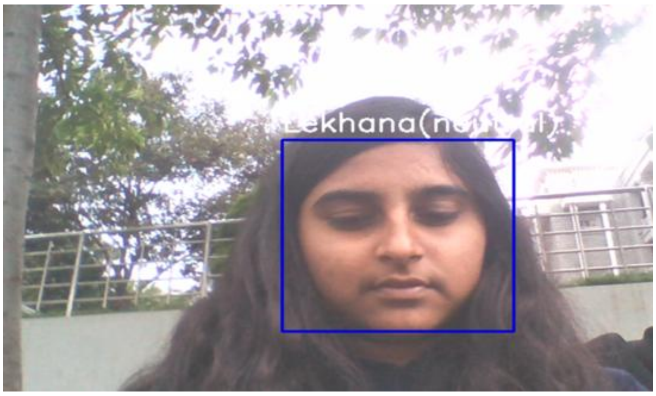

Fig 9: Detecting image from expresses neutrality.

Figure 7.9 illustrates that the detected image face expresses neutrality through its facial expression.

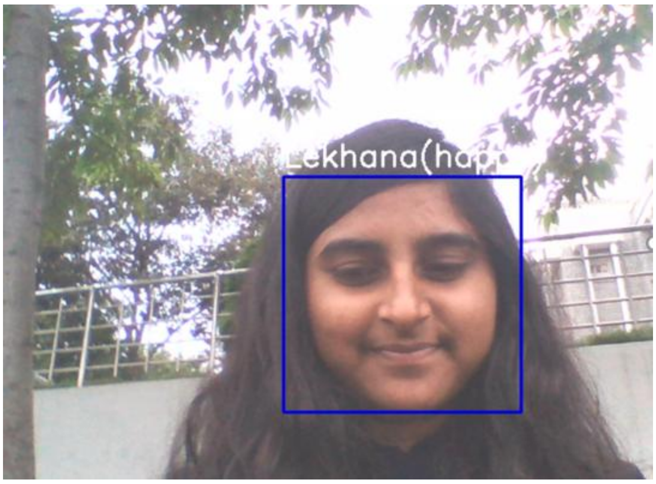

Figure 7.10: Detecting image face expresses happiness.

Figure 7.10: illustrates that the detected image face expresses happiness through its facial expression.

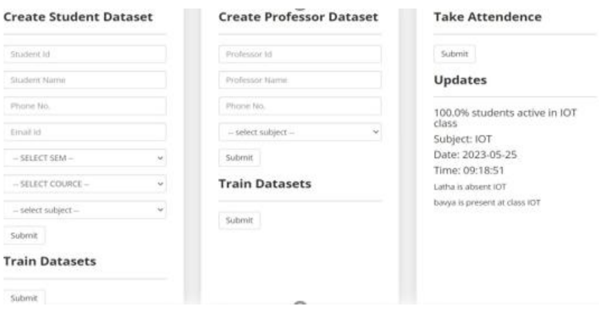

Figure 7.11: Predicting the Students' focus levels.

The figure 7.11 predicts overall activity provides information on the attendance status of students, indicating who is absent and present for each subject along with the corresponding date and time.

VII. CONCLUSION

Face recognition systems have garnered significant attention both in the commercial market and the field of pattern recognition. This project is focused on applying Principal Component Analysis (PCA) to the face recognition problem and proposed a face recognition system based on the eigenfaces approach, implemented using OpenCV. The algorithm's performance was tested on standard image databases like ORL and Indian Face Databases.

The developed algorithm demonstrated generalizability, working effectively with various types and sizes of images. The tests conducted on PGM and JPEG images of different subjects in diverse environments yielded very good face classification results. However, it did exhibit limitations in handling variations in lighting, size and head orientation. While the obtained results were acceptable, further improvements are needed to enhance the system's robustness and incorporate other discriminant features.

The eigenface approach presents a viable and effective solution for face recognition, known for its speed, simplicity, and effectiveness in limited settings. However, to become a fully functional real-world system, it requires further improvements and adaptability to diverse conditions.

FUTURE WORK:

In the future, this face recognition system can be extended to mobile-based applications, enabling real-time analysis of students' focus levels using their mobile devices. Integration with CCTV cameras can offer enhanced monitoring capabilities, while exploring alternative recognition algorithms can lead to more effective and accurate results for analyzing students' attentiveness in both online and offline learning environments.

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