International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

Student Engagement Monitoring in Online Learning Environment

[1*]Vijaya U. Pinjarkar, [2]Umesh S. Pinjarkar, [3]Harsh Namdev Bhor, [4]Yogeshwari V. Mahajan, [5]Vishal Ratansing Patil, [6]Satpalsing Devising Rajput, [7]Parth Kothari, [8]Dhruv Ghori, [9]Harish Parshuram Bhabad

Submitted: 21/08/2023 **Revised:** 11/10/2023 **Accepted:** 22/10/2023

Abstract: Students engagement is one of the most important factors in student achievement. Many schools are aware of this and have initiated programs to monitor how engaged students are in school. Tracking student engagement not only helps teachers assess their teaching methods, it also helps administrators know which aspects of the school environment need more attention. In order to measure student engagement, many schools can incorporate systems that track a child's response time during individual lessons. We all know that the internet has changed education forever, and for the better. An accessible online world has allowed students to learn at their own pace in a more natural environment with new opportunities for collaboration, creativity, and growth. But what is not commonly understood is just how crucial student engagement on an online course can be to its success. Student engagement is fundamental to educational success. Engagement monitoring can help identify what students find interesting and engaging in the classroom, what they want, what makes them uncomfortable, and what they need.

Keywords*: Online Monitoring, Face Recognition, Student Engagement.*

1. Introduction

Online learning, while potentially prestigious, carries a stigma of "lack of engagement" from the oftentimes-lonely student. With so much time being spent in isolation, there is often less face to face contact with other students and instructors. Here will discuss how a thriving online course can maintain high levels of engagement with an engaging syllabus and interactive assignments. We will also introduce a free tool for monitoring student activity in the class to help keep everyone engaged through data collection and analysis.

Online learning and the technologies that go along with it have the potential to make higher education both more expensive and accessible. This accessibility, while potentially a good thing in that it will allow for more students who otherwise would not be able to attend college, can also result in a significantly reduced overall quality of learning. While an online course can be just as rigorous as a traditional one, it must be monitored carefully to ensure all students are on track. The syllabus must always remain the same. The assignments must always be submitted on time. In this research the focus is on just one question: how do you know the students are getting what they need out of the class, and are they engaged?

Student engagement is critical for retention, success and efficacy of online learning. It has been found that student engagement often leads to greater satisfaction during the education process which can, in turn lead to better participation in other activities as well. There are various ways for instructors and educators to engage students while providing effective feedback through assessment and beyond.

1.1. Motivation

Active learning necessitates student involvement and interest in the classroom. To do this, they must be extremely motivated. To put it another way, highly motivated students make an effort to participate in class. As a result, understanding a student's degree of motivation is crucial for

*1*Assistant Professor, K J Somaiya Institute of Technology, Sion, Mumbai, India.*
2Assistant Professor,Saraswati College of Engineering, Kharghar, Mumbai, India.
3Assistant Professor, K J Somaiya Institute of Technology, Sion, Mumbai, India.
4Assistant Professor, Department of Computer Engineering, Pimpri Chinchwad College of Engineering and Research, Ravet, Pune, Maharashtra, India.
5Assistant Professor, Department of Computer Science and Engineering(AIML), Pimpri Chinchwad College of Engineering Nigdi, Pune, Maharashtra, India.
6Assistant Professor, Department of Computer Engineering, Pimpri Chinchwad College of Engineering Nigdi, Pune, Maharashtra, India.
7UG Student, K J Somaiya Institute of Technology, Sion, Mumbai, India.
8UG Student, K J Somaiya Institute of Technology, Sion, Mumbai, India.
9Asst. Professor, Loknete Gopinathji Munde Institute of Engineering and Education Research, Nashik, Maharashtra, India.
**Corresponding Author Email: vkhirodkar@somaiya.edu*

active engagement in class. According to one of the study student's motivation level is dependent on participation in the class. Vocational study students are more affected by motivating aspects, and motivation level decreases as grade level decreases.

1.2. Objectives

- To authenticate the student that they themselves are attending the lecture or not.
- To simplify teachers / professors tasks for attendance monitoring.
- To improve the effectiveness and efficiency of online learning.

1.3. Scope

There are many benefits of monitoring students' progress in the classroom online classroom. The consistent and unceremonious assessment provides teachers the valuable statistics of the students' progress and achievement. Further students' progress monitoring in online class, give opportunity to teachers, to create fluctuations in teaching aids and use of different and innovative methods.

The second benefit of the proposed method is that it allows the teachers to evaluate effect of the teaching methods they are being used. In case, if the class finds teaching method is difficult then their facial expression will change and the same are noted by teachers. As a result, teachers can help students reach their educational goals. With information collected from assessment and activity samples, in the proposed method, the teachers and students work together to establish learning goals which are achievable and help each student stay on the leaning track. With continuous student supervision, teachers can establish an achievable and individual level of progress for each learner or vice versa and intervene where necessary.

2. Related Work

Authors in paper [1] explained, a method for detecting learner participation has been created using the (LDP) local direction pattern and (DBN)deep belief network. In each frame, facial characteristics were extracted as LDP-histograms by applying a fixed mask to interested identified face region. During classification, involvement detection judgements were conducted at two levels (not engaged and engaged) and three levels (not engaged, usually engaged, and extremely involved).

Authors in [2] discussed about the engagement detection, authors leverage behavioral and emotional data from students. As well as compared different algorithms like deep convolutional network, network to network, convolutional network, conv-pool conventional network based on various parameters.

Authors proposed model combining some special features from the above models have been tested for behavioral and emotional dimensions' detection to detect student engagement in online learning.

In [3], During a lesson, a web application was created to facilitate various sorts of student-teacher interaction. The Programme collected all of the auditory exchanges and labelled the data so that further analysis of the data could be done quickly.

In [4] authors used, the open source dataset to demonstrate a Web Camera Based system for evaluating the possibilities of automated student engagement monitoring and assessment. A case study was conducted to acquire insight into the earnest challenges of student engagement detection and identification when students are allowed to sit and move freely during learning. The student images from the dataset are used to train a deep learning CNN model, which is then used for real time monitoring and assessment of student involvement.

In [5], The idea is to make existing facial recognition systems more accurate. From still pictures and video frames, face recognition is possible.

The authors in [6], discussed about the monitors keyboard, mouse, and clickstream data. A webcam for estimating head pose. Browser tab activation, upgrades and deletions, and website screenshots are all possible. Listener for browser information and window focus

The [7], It measures the engagement of the student through facial recognition by detecting various features of students face such as head pose, facial fiducial points, learned features, eye gaze, etc.

In [8], authors explain the depends on-head stance & basic facial gestures viz. brow raise, eye closure, and upper lip rise to form their judgments about interest.

Authors in [9], explain the use of applied machine learning to educational data acquired in the hybrid leaning environment. The study focused on the correlations between the student's academic achievement and student's engagement level with how the machine learning algorithms might assistance educator's in inevitably monitoring as well as responding to students queries which in turn outcomes to focus on the different pedagogical issues.

Authors in [10] Proposed a system where people rely to perform various task. It mainly discusses about the adversarial attack. The escalation of "deep learning" and "neural networks" took several opportunities and applications.

3. Proposed System

This System will identify whether the student is attending the lecture or not, and the tool automatically registers the

time he/she is in class (class start time relative to the system's clock). It also gathers his or her head position. Our aim will be to have a score of attentiveness and an average score per each student. Based on the results system will be give feedback, recommend activities and observe the student's behavior also be monitoring mouse and keyboard clicks. If the student is not attending, system will notify the instructor and tracking some of the elements such as browser tabs, website snapshots and other activity. System contains "Dashboard" for instructors to present to their students with their average student engagement levels. The dashboard will contain a lot of valuable information for instructors such as classes with low engagement levels, students who are not attending lectures etc. The information collected from our tracking system can be used in many different ways such as improving classroom or lecture training and how to improve student performance i.e. what questions should be asked during each lecture, what questions should be asked after each lecture etc. and it will authenticate students via facial recognition and head pose estimation.

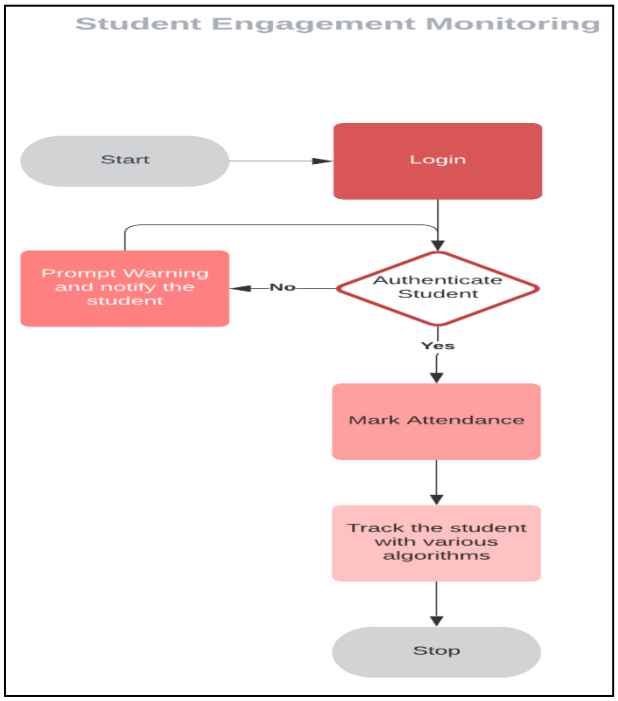

Fig 1: Block Diagram of Proposed System

4. Implementation

The system working is divided into two parts:

A) Students Face Recognition

B) Students Attendance Marking

4.1. Face Recognition

Face recognition is a technique which uses image, video and other audio-visual feature of a human face for identification and authentication. Such type of identification is frequently used to get access to a software, smart-device, smart-system, service etc.

The proposed system is a biometric identification and authentication methodology that depend on body measurements. Here system calculates distance like the distance between face and head.

in this instance the face and head, to authenticate a person's identity. The system captures a collection of unique biometric data related with a person's face and facial expression in order to identify, verify, and/or authenticate them. Created a face recognition model using React.js which gives us the emotion of students as they are neutral, sad, happy, surprised etc. and face landmarks also.

Computerized face recognition is a technology used to identify or verify a person from their facial biometric pattern and data. This is based on the analysis of certain body measures that make it possible to recognize the person that is being checked. Face recognition uses computer, software and hardware technology to detect process, match and compare facial data of people in an image or video file. The system has three steps:

- Pre-Processing
- Feature Extraction
- Matching

4.2. Mark the Attendance for Students

Created a Dataset in that which stored images of the students and through face recognition will compare the face with the image stored in database and if it matches then only it will mark the attendance.

To check the attentivenes of the Student, using the DAiSEE Dataset which will help us to identify the boredom of Students and Head Pose Estimation.

i) DAiSEE

With 9068 video samples from 112 people, DAiSEE is the world's first multi-label video classification dataset for identifying user emotive states of engagement, boredom, perplexity, and discontent in the wild. For each of the emotional states, there are four degrees of labels: low, very low, high, and very high.

ii) Head Pose Estimation

Head pose estimation is a computer vision technique for predicting and tracking a human being. This is accomplished by observing a person's posture and orientation in combination.

A. Two-Step Approach to Head Pose Estimation

First, as a preprocessing step need to apply a face detection algorithm to an image to detect regions of interest, human faces, presented in the image. One could use any DL-based method for face detection, including Faster R-CNN or SSD

(available in OpenCV). This step is required to find regions that are cropped from the image and then are processed further in the next steps of the algorithm.

A possible result of the face detection algorithm:

Fig 2: Face Detection Example

B. Establish the correspondence between 2D facial landmarks in the image and their 3D positions.

Second, need to establish the correspondence between 2D facial landmarks in the image and their 3D positions. Under facial landmarks, mean some facial keypoints, e.g. eyes, eyebrows, a nose tip, lips, chin, etc. Obtaining this alignment is necessary for the next step of the algorithm, where the alignment will be used for the optimization procedure.

5. Results and Discussion

The DAiSEE dataset used to identify whether or not a student was bored and if they were attentive. For this system, prepared a Dataset of the students and took pictures of them. After then placed one picture for each student under each name so that one could use face recognition to compare it with their own photo and mark where they were sitting during lecture.

After applying the proposed system, Figure 3, shows that the student attending online class is neutral. The emotion recorded in database is neutral emotions. Student is trying to understand topics in online classes.

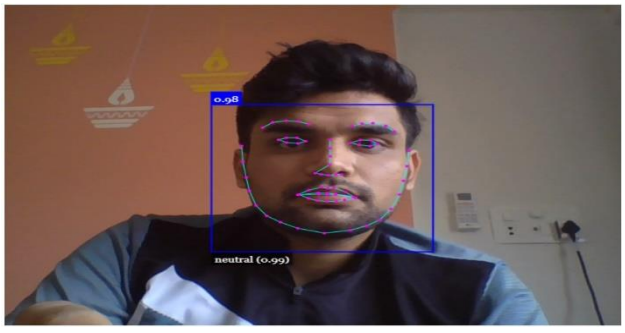

Fig 3: Neutral Emotion

After applying the proposed system, Figure 4, shows that the student attending online class is happy. The emotion recorded in database is happy emotions. Student is understood the topics and also enjoying the online class.

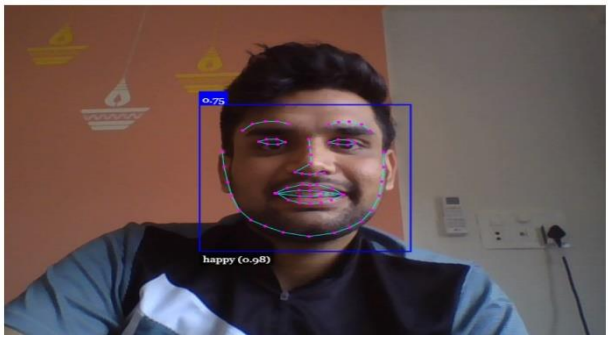

Fig 4: Happy Emotion

After applying the proposed system, Figure 5, shows that the student attending online class is sad. The emotion recorded in database is sad emotions. Student is not understanding the topics and also not enjoying the online class. The feedback of this record is given to tutor and ask to take action like make the changes in teaching methods, addition of animations, inclusion of pedagogy methods etc.

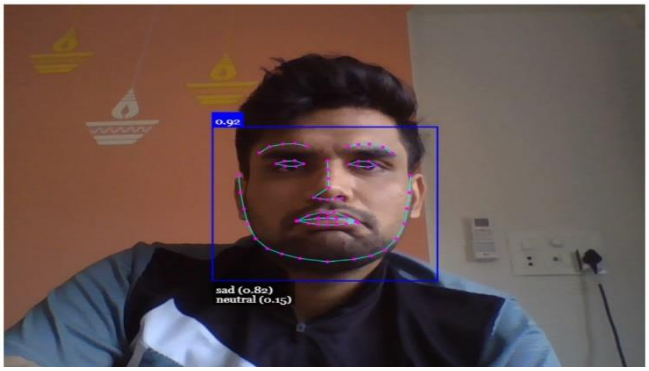

Fig 5: Sad Emotion

After applying the proposed system, Figure 6, shows that the student attending online class is surprised. The emotion recorded in database is surprised emotions. Student is understood the topics and also enjoying the online class. The surprised emotion is stating that the student is active in online class

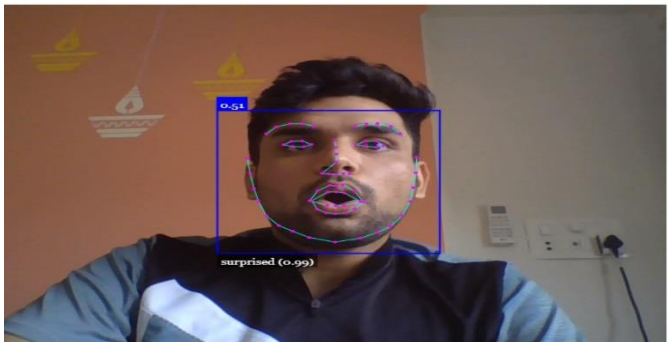

Fig 6: Surprised Emotion

Figure 7, is landing page of proposed system. If the user is

visiting system first time, then the user must register first by clicking “First time user” or already register user can click on “Get Started” option.

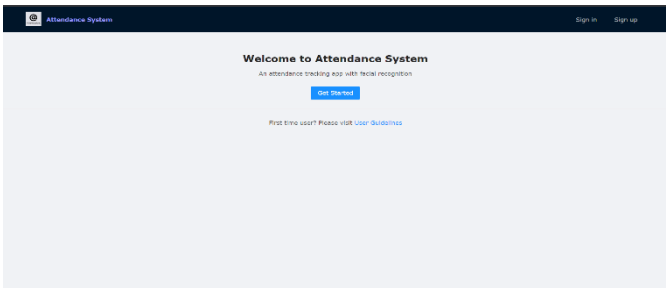

Fig 7: Login Page

Figure 8, shows the “Add Course Form” this page is for tutors / professors, here professor add details about the course like “Course Name”, “Course Code” and “Course Session i.e. time duration” etc.

Figure 9, shows the course page, where tutors / professors are able to check the number of participants in online class also can create attendance by clicking “Create Attendance” option and download attendance by clicking “Download Attendance” option.

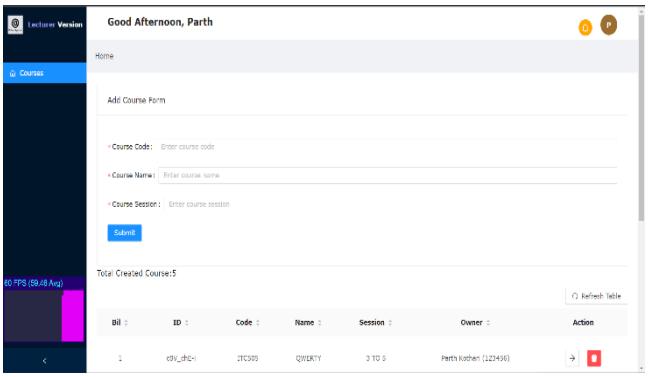

Fig 8 : Lecturer Page

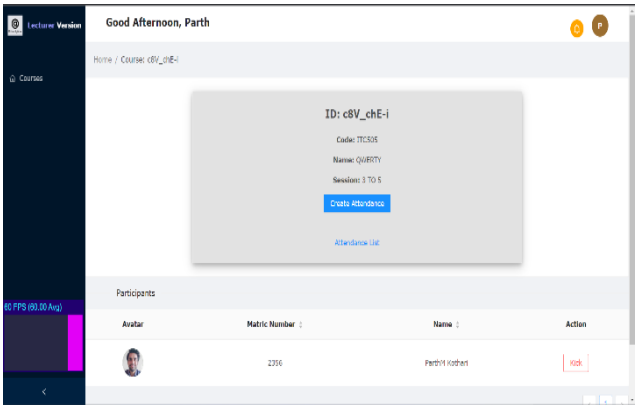

Fig 9 : Course Page

Figure 10 shows the student page, where register students can see the various available courses.

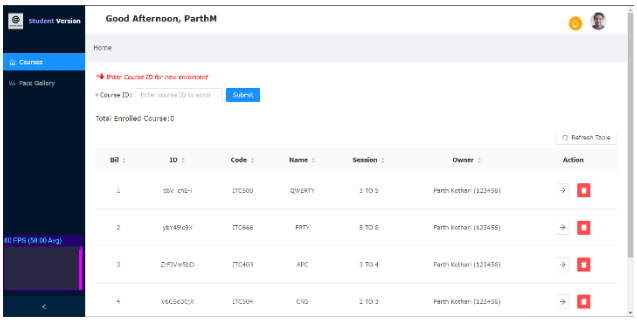

Fig 10 : Student Page

Figure 11, Shows the students attendance input page. Here student select details like webcam, its size etc.

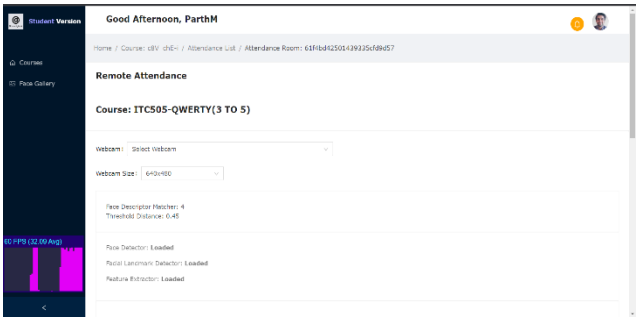

Fig 11: Student Attendance Input Page

Figure 12, shows the Student Attendance Recognition Page where proposed system matches the student face with the images stored in database.

Once the student selects course and complete authentication process, the check-in time for that course is displayed on screen.

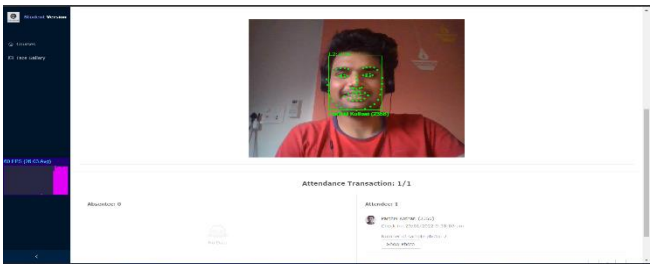

Fig 12: Student Attendance Recognition Page

6. Conclusion

The paper discussed about the research implementation, carried out to check student engagement in online teaching mode. Student’s facial express says a lot thing like they are enjoying, understanding teaching or just seating in online class for sake of attendance. If the student is not giving proper attention in the online class, then proposed system will send notification to instructor. The propose system monitor the student mouse and keyboard clicks also and maintain students IN and OUT time in online class. Based on student involvement in the class the feedback sends to tutor / professors. System also be tracking some of the elements such as browser tabs, website snapshots and other

activity, the dashboard for instructors is provided to present to their students with their average student engagement level in the online class. The dashboard will contain a lot of valuable information for instructors such as classes with low engagement levels, students who are not attending lectures etc. The information collected from proposed tracking system can be used in many different ways such as improving classroom or lecture training and how to improve student performance i.e. what questions should be asked during each lecture, what questions should be asked after each lecture etc. and it will authenticate students via facial recognition and head pose estimation.

References

[1] Dewan M. A. A., Lin F., Wen D., Murshed M. & Uddin Z., A Deep Learning Approach to Detecting Engagement of Online Learners, 2018 IEEE SmartWorld, Ubiquitous Intelligence & Computing, Advanced & Trusted Computing, Scalable Computing & Communications, Cloud & Big Data Computing, Internet of People and Smart City Innovation (SmartWorld/SCALCOM/UIC/ATC/CBDCom/IOP/SCI), pp1895-1902, 2018.

[2] Dash S., Akber DewanM. A., Murshed M., Lin F. , Abdullah-Al-Wadud M. & Das A., A Two-Stage Algorithm for Engagement Detection in Online Learning, 2019 International Conference on Sustainable Technologies for Industry 4.0 (STI), pp. 1-4, 2019.

[3] C. Arce-Lopera, J. J. Cardona and F. García, "Acoustic Monitoring System for Teacher and Student Engagement Evaluation," 2020 15th Iberian Conference on Information Systems and Technologies (CISTI), 2020, pp. 1-4, doi: 10.23919/CISTI 49556.2020.9140442.

[4] Y. Wang, A. Kotha, P. -h. Hong and M. Qiu, "Automated Student Engagement Monitoring and Evaluation during Learning in the Wild," 2020 7th IEEE International Conference on Cyber Security and Cloud Computing (CSCloud)/2020 6th IEEE International Conference on Edge Computing and Scalable Cloud (EdgeCom), 2020, pp. 270-275, doi: 10.1109/CSCloud-EdgeCom49738.2020.00054.

[5] M. Geetha, R. S. Latha, S. K. Nivetha, S. Hariprasath, S. Gowtham and C. S. Deepak, "Design of face detection and recognition system to monitor students during online examinations using Machine Learning algorithms," 2021 International Conference on Computer Communication and Informatics (ICCCI), 2021, pp. 1-4, doi: 10.1109/ICCCI50826.2021.9402553.

[6] D. Preuveneers and W. Joosen, "Edge-Based and Privacy-Preserving Multi-Modal Monitoring of Student Engagement in Online Learning Environments," 2019 IEEE International Conference on Edge Computing (EDGE), 2019, pp. 18-20, doi: 10.1109/EDGE.2019.00017.

[7] Alkabbany, A. Ali, A. Farag, I. Bennett, M. Ghanoum and A. Farag, "Measuring Student Engagement Level Using Facial Information," 2019 IEEE International Conference on Image Processing (ICIP), 2019, pp. 3337-3341, doi: 10.1109/ICIP.2019.8803590.

[8] J. Whitehill, Z. Serpell, Y. Lin, A. Foster and J. R. Movellan, "The Faces of Engagement: Automatic Recognition of Student Engagementfrom Facial Expressions," in IEEE Transactions on Affective Computing, vol. 5, no. 1, pp. 86-98, 1 Jan.-March 2014, doi: 10.1109/TAFFC.2014.2316163.

[9] F. Orji and J. Vassileva, "Using Machine Learning to Explore the Relation Between Student Engagement and Student Performance," 2020 24th International Conference Information Visualization (IV), 2020, pp. 480-485, doi: 10.1109/IV51561.2020.

[10] H. Mav, A. Mokashi, S. Nanduri and V. Pinjarkar, "Face Recognition and Adversarial Masking Techniques," 2022 3rd International Conference for Emerging Technology (INCET), 2022, pp. 1-7, doi: 10.1109/INCET54531.2022.9825044.

[11] Abhay Gupta, Arjun D'Cunha, Kamal Awasthi, Vineeth Balasubramanian, "DAiSEE: Towards User Engagement Recognition in the Wild" arXiv:1609.01885 [cs.CV],

[12] B. H. K. T., H. M. Perera, S. Kumarage, P. A. P. Savindri, D. Kasthurirathna and A. Kugathasan, "E-Learn Detector: Smart Behaviour Monitoring System to Analyze Student Behaviours During Online Educational Activities," 2021 3rd International Conference on Advancements in Computing (ICAC), 2021, pp. 19-24, doi: 10.1109/ICAC54203.2021.9671073.

[13] S. Dash, M. A. Akber Dewan, M. Murshed, F. Lin, M. Abdullah-Al-Wadud and A. Das, "A Two-Stage Algorithm for Engagement Detection in Online Learning," 2019 International Conference on Sustainable Technologies for Industry 4.0 (STI), 2019, pp. 1-4, doi: 10.1109/STI47673.2019.9068054.

[14] F. Orji and J. Vassileva, "Using Machine Learning to Explore the Relation Between Student Engagement and Student Performance," 2020 24th International Conference Information Visualisation (IV), 2020, pp. 480-485, doi: 10.1109/IV51561.2020.00083.

[15] M. A. A. Dewan, F. Lin, D. Wen, M. Murshed and Z. Uddin, "A Deep Learning Approach to Detecting

Engagement of Online Learners," 2018 IEEE SmartWorld, Ubiquitous Intelligence & Computing, Advanced & Trusted Computing, Scalable Computing & Communications, Cloud & Big Data Computing, Internet of People and Smart City Innovation (SmartWorld/SCALCOM/UIC/ATC/CBDCom/IOP/SCI), 2018, pp. 1895-1902, doi: 10.1109/SmartWorld.2018.00318.

[16] B. M. da Silva et al., "GuitarEasy - An Interactive Approach to the Study of Music Theory," 2021 16th Iberian Conference on Information Systems and Technologies (CISTI), 2021, pp. 1-6, doi: 10.23919/CISTI52073.2021.9476472.

[17] X. Li, C. Shao, Y. Zhou and L. Huang, "Face Mask Removal Based on Generative Adversarial Network and Texture Network," 2021 4th International Conference on Robotics, Control and Automation Engineering (RCAE), 2021, pp. 86-89, doi: 10.1109/RCAE53607.2021.9638866.

[18] J. Whitehill, Z. Serpell, Y. -C. Lin, A. Foster and J. R. Movellan, "The Faces of Engagement: Automatic Recognition of Student Engagementfrom Facial Expressions," in IEEE Transactions on Affective Computing, vol. 5, no. 1, pp. 86-98, 1 Jan.-March 2014, doi: 10.1109/TAFFC.2014.2316163.

[19] Zixiang Fei, Erfu Yang, Leijian Yu, Xia Li, Huiyu Zhou, Wenju Zhou, "A Novel deep neural network-based emotion analysis system for automatic detection of mild cognitive impairment in the elderly Neurocomputing", Volume 468, Pages 306-316, ISSN 0925-2312, 2022.

[20] V. Laijawala, A. Aachaliya, H. Jatta and V. Pinjarkar, "Classification Algorithms based Mental Health Prediction using Data Mining," 2020 5th International Conference on Communication and Electronics Systems (ICCES), 2020, pp. 1174-1178, doi: 10.1109/ICCES48766.2020.9137856.

[21] V. Pinjarkar,Jain Amit, B. Bhasker, P.Srivastava, "Pertinent Exploration of Privacy Preserving Perturbation Methods" international Journal of Recent Technology and Engineering, 8(6), 2020, 1945-1949

[22] Terdale, J. V. ., Bhole, V. ., Bhor, H. N. ., Parati, N. ., Zade, N. ., & Pande, S. P., "Machine Learning Algorithm for Early Detection and Analysis of Brain Tumors Using MRI Images", International Journal on Recent and Innovation Trends in Computing and Communication, 11(5s), (2023), 403–415. https://doi.org/10.17762/ijritcc.v11i5s.7057

[23] Harsh Namdev Bhor, Mukesh Kalla, "TRUST-based features for detecting the intruders in the Internet of Things network using deep learning", Computational Intelligence, 38(2), (2022), 438-462. https://doi.org/10.1111/coin.12473

[24] Bhor, H.N., Kalla, M. "A Survey on DBN for Intrusion Detection in IoT". In: Zhang, YD., Senjyu, T., SO–IN, C., Joshi, A. (eds) Smart Trends in Computing and Communications: Proceedings of SmartCom 2020. Smart Innovation, Systems and Technologies, vol 182. Springer, Singapore. https://doi.org/10.1007/978-981-15-5224-3_33

[25] V. Pinjarkar, A. Jain., A. Bhasker, P Shrivastava , "Mental Health Disorder and Privacy Preserving Data Mining: A Survey", in book "The Role of IoT and Blockchain", pp. 441–449, Taylor and Francis Group, (2022), 1 st Edition.

[26] H. N. Bhor and M. Kalla, "An Intrusion Detection in Internet of Things: A Systematic Study," International Conference on Smart Electronics and Communication (ICOSEC), Trichy, India, (2020), pp. 939-944, doi: 10.1109/ICOSEC49089.2020.9215365.

[27] Isabella Rossi, Reinforcement Learning for Resource Allocation in Cloud Computing , Machine Learning Applications Conference Proceedings, Vol 1 2021.

[28] Deshpande, V. (2021). Layered Intrusion Detection System Model for The Attack Detection with The Multi-Class Ensemble Classifier . Machine Learning Applications in Engineering Education and Management, 1(2), 01–06. Retrieved from http://yashikajournals.com/index.php/mlaeem/article/view/10