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A Review on Students Attention Monitoring Systems

Parvathy G S [1], Smitha R [2]

[1]Lecturer, Dept. of Computer Engineering, NSS Polytechnic College, Pandalam, Kerala
[2]Lecturer, Dept. of Electronics and Communication Engineering, NSS Polytechnic College, Pandalam, Kerala

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Abstract –*Blackboard lectures with slides are still a popular teaching method. The fact that lectures frequently keep learners in a passive state is one issue with this method. Passive listeners may find it challenging to stay focused and pay attention throughout a lecture. This can make the lecture less effective in terms of learning results. This approach does not provide teachers with real-time feedback. The ability to assess the attention of students is the foundation for improving both instructional delivery and student learning. A teacher has difficulty tracking and monitoring every student's interest in learning, especially in a large classroom. This study reviews the various currently existing student attention monitoring systems, that automatically monitors students' attention level and gives live feedback to teacher.*

Key Words: ***Face Detectors, Discrete Wavelet Transform (DWT), Support Vector Machine (SVM), Haar Cascade Classifier, Convolutional Neural Network (CNN), Face Alignment Network, Electroencephalograph(EEG), Kinect Sensor, Histogram of Gradient (HOG) descriptor, Fisherface Algorithm***

1. INTRODUCTION

In traditional face-to-face instruction, teachers generally observe students' facial expressions to determine whether they are sufficiently attentive. However, this method is excessively subjective and consumes a significant amount of the teacher's energy. In addition to face-to-face instruction, e-learning allows However, students may become easily distracted in e-learning environments, owing to the absence of a teacher's face-to-face supervision Despite the importance of maintaining sustained attention during a learning activity to ensure successful learning, evaluating whether students maintain their concentration on a learning activity is extremely difficult, owing to the lack of supervised mechanisms to monitor their attention states [1].

This article examines different student attention level assessing systems. In Chapter 2, the various methods of assessments are discussed. The comparison of the various approaches is shown in Chapter 3. The study's conclusion is presented in Chapter 4.

2. LITERATURE REVIEW

Using raw human EEG data captured by Neurosky's Mind Wave earphone, a novel attention-aware system (AAS) has been presented in [2]. Then, Continuous performance tests (CPTs) are used to collect attention responses from students and their corresponding EEG signals. Using NeuroSky's brainwave detector and the support vector machine (SVM), the AAS is constructed. The recorded EEG signals are then divided into five major bands (alpha, beta, gamma, theta, and delta), each of which has five statistical parameters, using discrete wavelet transforms (DWT). Based on twenty-five unique brainwave properties related to attention levels, the AAS is constructed. The proposed Attention awareness system has a 90.39% accuracy rate.

An attention-tracking system that just requires a simple web camera in real-time is developed in [3]. In addition to scale and rotation invariant, this system is also tolerant to incorrect attention state classifications brought on by blinks. The facial region is identified by using Haar Cascade Classifier. Using a Haar Cascade Classifier tailored for eye identification, the positions of both eyes are identified. Following the detection of the inner and outer corner points of the eyes in a frame, the Lucas-Kanade tracker will detect the corner nodes in consecutive frames. The average intensity in the ROI region following the subtraction procedures is used to assess attention. A feedback channel is incorporated in an active attention-tracking system to warn the user with alarm signals when inattentiveness is identified. The database will keep the attention status and the accompanying bookmarks for the E-learning content.

The method of assessing student attention spans through facial landmarks was proposed in [4]. Lips and eyes on the face are highlighted here as areas of special importance.. Aspect ratios for the eyes and mouth were calculated, as well as threshold values. A face detector that combines the Histogram of Oriented Gradients (HOG) and Linear Support Vector Machine (SVM) techniques were used find the student's face. Student states were determined based on the coordinates of the eyes, mouth, and face landmarks: 'Normal', 'Dozing', or 'Yawning'. The basis for yawning, nodding off, and paying attention is a fixed number of consecutive frames that shouldn't be exceeds the maximum. A display showing the determined states is directly visible to students and instructors.

In [5], students' level of concentration was assessed using a deep learning approach. The system utilizes two types of facial cues to determine student concentration levels. They include gaze and fatigue detection. Consistent identification of both cases can be accomplished by identifying face regions like the eyes and lips. Face Alignment Network (FAN) has been used to detect the 68 facial landmarks. Faces were recognized here, and landmarks are followed for a variety of facial expression assessments in facial analysis module of the system. Euler angles are used to calculate face orientation and gaze orientation. A CNN can be trained to transform 2D facial feature values into corresponding 3D models by estimating facial orientation. The first step in analyzing student activity involves capturing skeletal movements and detecting classroom items. Through view-point invariant analysis, this can identify up to 8 different types of student activity. This system can be developed by making use of Conventional RGB camera unlike other student attention monitoring systems.

A student monitoring system based on Kinect Sensor has been developed in [6]. The system makes use of several cams to track each student's conduct in the lecture room. Based on visual indicators, the monitoring system may be able to spot a drop in student involvement. A video analysis system was developed, allowing individual monitoring of every student in class. Students can be monitored from multiple angles through the system. On a stable holder, a high-definition Microsoft Kinect 2 was placed in front of students to record videos and track visual signals. The anterior view of the students was covered by the gadget, which met most of the criteria's for observing facial expressions, tracking gaze, and body actions. A standard HD digital video camera capturing video to a DV tape has been used as a second video source. The two video feeds were integrated to ensure a full degree student behavior monitoring. Using the Kinect software development kit coupled with MATLAB, the observed attributes have been retrieved in offline mode.

A deep learning-based approach for student attention monitoring from classroom behavior has been introduced in [7]. The suggested method was successful in giving the student a numerical rating for their degree of classroom attentiveness. A deep learning algorithm and a web camera make up the suggested model. The device actively monitors the students during the class and plots in real-time their attention level, expressions, and participation. The camera records a camera stream from the class. Students are facing a web camera that is directly connected to a laptop. This whiteboard-mounted camera captures pictures of the entire class. Reports on attendance and emotional state are provided for each class and group of students. Here, the student actions and expressions are classified into two categories: high attention and poor attention. Raising hands and focusing are signs of high attention. Boredom, eating/drinking, laughing, using the phone, sleeping, thinking etc. are all examples of low attention activities. The face detection algorithms utilized here are the Fisherface algorithm, Eigenface detection, HaarCascade algorithm. YOLO5 has been mainly used for object detection. The suggested approach makes it feasible to report actions and behaviors, thoughts, and student attendance in real-time.

'Classquake', a system used to identify students' declining attention levels, has been implemented [8]. It consists of a Class quake seismometer mobile application. Student smartphones gather information from the accelerometers as they move, and if the intensity surpasses a certain number, they release an anonymous wave message. A database user (teacher) receives and stores wave messages. The Wave Message Subscriber is a useful tool during classes. The Wave Message Store is where classes' wave messages are collected for further processing. The Web Application gives data to teachers. For exhibition, it processes both the wave messages and the stored information. Class quake Alarm alerts the teacher in case of "critical" conditions by vibrating the smartphone. An online user interface is also included which offers visual data with in-depth seismic data of class quakes, either live or history. The instructor configures the system by entering course information and starts the assessment prior to a lecture.

A student concentration level monitoring system has been developed [9] via face detection. Onee of the major factors that determines whether a student is alert in the classroom is facial recognition. The eye location and lip position are determined first, followed by the attentive parameters. When a face is identified, features are retrieved to assess the student's level of attention. Following processing step, the features are stored.A web camera built inside the smart classroom collects student images and sends them to the CTF tool. Real-time photos can be moved more easily with CTF for additional recognition and analysis. To make the acquisitions suitable for other processes, they are enhanced and smoothed. They are then fed into a Multitasking Deep Neuro-Fuzzy Model. Skin colour-based segmentation allows for the identification of several faces in one image. The modified blob analysis is used to retrieve the faces from the final image. Based on the Fuzzy rules, the students have been split into active and inactive groups. Users are shown categorised results that include a picture of the student and their information.

4. COMPARISON

The comparison of the different student attention monitoring systems is shown in Table 1.

Table 1: Comparison of different student attention monitoring systems

No	Name	Physiological Parameters	Sensor Position	Techniques/Technologies used
1	Assessing the attention levels of students by using a novel attention-aware system based on brainwave signals.[2]	EEG signal acquisition system	EEG signal features	NeuroSky brainwave detector Support vector machine (SVM) DWT
2	Attention analysis in e-learning environment using a simple web camera[3]	Webcamera	Face features	Haar Cascade Classifier Lucas Kanade Tracker
3	Students Attention Monitoring and Alert System for Online Classes using Face Landmarks [4]	Web camera	Eye aspect ratio, Mouth ratio	HOG SVM
4	A Video Analytic In-Class Student Concentration Monitoring System [5]	RGB Camera	Yawn rate, facial orientation, gaze, fatigue behavior	Open source Dlib CNN, Face alignment network
5	Kinect based system for student engagement monitoring [6]	Microsoft Kinect HD digital video camera	Facial Expression, eye gaze, Behavior cues, Body movements	Microsoft Kinect
6	Smart Classroom: A Deep Learning Approach towards Attention Assessment through Class Behavior Detection [7]	Webcamera	Student face	Deepsort Algorithm, YOLO5 model, Fisher face algorithm,Eigenface detector, HaarCascade Algorithm
7	Classquake: Measuring Students' Attentiveness in the Classroom [8]	Classquake seismometer app	Noise level in Classroom	Classquake Seismometer app, Web app
8	SAttentiveness Measure in Classroom Environment using Face Detection [9]	High pixel resolution Camera	Face features (Lip,Eye)	MDNFM CTF Tool

5. CONCLUSION

When students are instructed face-to-face, teachers generally observe their facial expressions to determine whether they are paying attention. The teacher's efforts are generally expended on this method due to its excessive subjective nature. The typical lecture style appears to have a negative effect on students' attention, capacity to concentrate, and retention, according to a number of studies and reports. With the advancements in technology different automatic systems for monitoring students' concentration level has been developed. In this paper, different student attention monitoring systems and how they operate has been reviewed. In most of the systems reviewed, facial features like eye gaze rate, eye features, mouth ratio, are extracted for the assessment of student's level of attention.

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