**Face Recognition Drowsiness Detection**

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**Abstract**

In a physical classroom during a lecturing teacher can see the faces and assess the emotion of the class and tune their lecture accordingly, whether he is going fast or slow. He can identify students who need special attention. Digital classrooms are conducted via video telephony software program (ex: Zoom) where it’s not possible for medium scale class (25-50) to see all students and access the mood. Because of this drawback, students are not focusing on content due to lack of surveillance. While digital platforms have limitations in terms of physical surveillance but it comes with the power of data and machines which can work for you. It provides data in the form of video, audio, and texts which can be analysed using deep learning algorithms. Deep learning backed system not only solves the surveillance issue, but it also removes the human bias from the system, and all information is no longer in the teacher’s brain rather translated in numbers that can be analysed and tracked

**Key words**

Face recognition, Drowsiness, Attendance, Online classes, Eye detection, Eye Tracking.

**1.Introduction**

The Indian education landscape has been undergoing rapid changes for the past 10 years owing to the advancement of web-based learning services, specifically, eLearning platforms. Global E-learning is estimated to witness an 8X over the next 5 years to reach USD 2B in 2021. India is expected to grow with a CAGR of 44% crossing the 10M users mark in 2021. Although the market is growing on a rapid scale, there are major challenges associated with digital learning when compared with brick and mortar classrooms. One of many challenges is how to ensure quality learning for students. Digital platforms might overpower physical classrooms in terms of content quality but when it comes to understanding whether students are able to grasp the content in a live class scenario is yet an open-end challenge. In computer science, image processing is the use of computer algorithms to perform image processing on images. As a subcategory or field of digital signal processing, image processing has many advantages over analogy image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions digital image processing may be modelled in the form of multidimensional system.

**Problem Description**

Due to distance education there is a gap created between student and teacher with less interaction and no physical presence grasping of the students becomes very less. On the other hand, with black board and chalk student will get more understanding to tackle this problem during live class of students we will access the web cam and with drowsiness of student we will mark the attendance. This will help education system to change in distance education and student will get more focused.

**2. Data Description**

Data here used for training purpose is known faces with the help of them we will train data and for testing we can use image from dataset or from live web cam.

**3.1 Behavioural Based Techniques**

The different techniques used in behavioural based parameters are:

**3.1.1. Eye Tracking and Dynamic Template Matching**

To avoid road accidents, real time driver fatigue detection system based on vision is proposed. Firstly, system detects the face of driver from the input images using HSI colour model. Secondly, Sobel edge operator is used to locate the eyes positions and gets the images of eye as the dynamic template for the tracking of eye. Then the obtained images are converted to HSI colour model to decide that whether the eyes are close or open to judge the drowsiness of driver. The experiments use four test videos for the tracking of eyes and face detection. The proposed system is compared with the labelled data which is annotated by the experts. The average correct rate of proposed system reaches up to 99.01 % and the precision to 88.90 %.

**3.1.2. Mouth and Yawning Analysis**

Fatigue is the major reason for road accidents. To avoid the issue, Sarada Devi and Bajaj proposed the driver fatigue detection system based on mouth and yawning analysis. Firstly, the system locates and tracks the mouth of a driver using cascade of classifier training and mouth detection from the input images. Then, the images of mouth and yawning are trained using SVM. In the end, SVM is used to classify the regions of mouth to detects the yawning and alerts the fatigue. For experiment, authors collect some videos and select 20 yawning images and more than 100 normal videos as dataset. The results show that the proposed system gives better results as compared to the system using geometric features. The proposed system detects yawning, alerts the fatigue earlier and facilitates to make the driver safe.

**3.1.3. Facial Expressions method** Laboratory condition using Finite Element Analysis is used by the researchers which is a complex system that contains the database of facial expression as a template and detect the drowsiness on the basis of results from database. Similarly, Assari and Rahmati present the hardware-based Driver Drowsiness Detection system based on facial expressions. The hardware system uses infrared light as it has giving many benefits like ease of use, independent of lightning conditions of environment. The system firstly uses the technique of background subtraction to determines the face region from the input images. Then using horizontal projection and template matching, facial expressions are obtained. After that in the tracking phase, elements found earlier are followed up using template matching and then investigates the incidence of sleepiness using the determination of facial states from the changes of the facial components. Changing in the three main elements such as eye brow rising, yawning and eye closure for the certain period are taken as the initial indications for drowsiness and the system generates the alert. The experiment is performed in the real driving scenario. For testing, images are acquired by the webcam under different conditions of lighting and from different people. The results investigate that the system produces appropriate response in the presence of beard or glasses and moustache on the face of driver.

**3.1.4. Yawning Extraction Method**

Fatigue or drowsiness is the major reason for road accidents. To prevent the issue, Alioua proposed the efficient system for monitoring the driver fatigue using Yawning extraction. Firstly, face region is obtained from the images using Support Vector Machine (SVM) technique to reduce the edge required cost. The proposed method is used to localize the mouth, detection technique is used to detects facial edges, then compute vertical projection on the lower half face to detect the right and left region boundaries and then compute the horizontal projection on the resulting region to detect the upper and lower limit of mouth and mouth localized region is obtained. Finally, to detect the yawning, Circular Hough Transform (CHT) is executed on the images of mouth region to identify the wide-open mouth. If the system finds notable number of continuous frames where the mouth is widely open, system generates the alert. The results are compared with the other edge detectors like Sobel, Prewitt, Roberts, Canny. The experiment uses 6 videos representing real driving conditions and results are presented in the form of confusion matrix. The proposed method achieves 98% accuracy and outperforms all other edge detection techniques.

**3.1.5. Eye Closure and Head Postures Method**

Teyeb proposed the Drowsy Driver Detection using Eye Closure and Head postures. Firstly, video is captured using webcam and for each frame of video, following operations are performed. To detect the ROI (face and eyes), viola-jones method is used. The face is partitioned in to three areas and the top one presenting the aye area is browsed by the Haar classifier. Then to detect the eye state, Wavelet Network based on neural network is used to train the images then the coefficients learning images is compared with the coefficients of the testing images and tells which class it belongs. When the closed eye is identified in the frames then the eye closure duration is calculated, if the value exceeds the predefined time then the drowsiness state is detected. Then the developed system estimates the head movements which are: left, right, forward, backward inclination and left or right rotation. The captured video is segmented into frames and extract the images of head and determines the coordinates of image. Then the images are compared to determine the inclined state of head and same case with other head postures. Finally, the system combines the eye closure duration and head posture estimation to measure the drowsiness. To evaluate the system, experiment is performed on 10 volunteers in various situations. And results show that the systems achieve the accuracy of 80%.

**3.1.6. Real Time Analysis Using Eye and Yawning**

Kumar proposed the real time analysis of Driver Fatigue Detection using behavioural measures and gestures like eye blink, head movement and yawning to identify the drivers’ state. The basic purpose of the proposed method is to detect the close eye and open mouth simultaneously and generates an alarm on positive detection. The system firstly captures the real time video using the camera mounted in front of the driver. Then the frames of captured video are used to detect the face and eyes by applying the viola-jones method, with the training set of face and eyes provided in OpenCV. Small rectangle is drawn around the centre of eye and matrix is created that shows that the Region of Interest (ROI) that is eyes used in the next step. Since the both eyes blink at the same time that’s why only the right eye is examined to detect the close eye state. If the eye is closed for certain amount of time it will be considered as closed eye. To determine the eye state, firstly the eye ball colour is acquired by sampling the RGB components on the centre of eye pixel. Then the absolute thresholding is done on the eye ROI based on eye ball colour and intensity map is obtained on Y-axis that show the distribution of pixels on y-axis which gives the height of eye ball and compared that value with threshold value which is 4 to distinguish the open and close eye. After that, if the eye blink is detected in each frame it will be considered as 1 and stored in the buffer and after the 100 frames, eye blinking rate is calculated. Then to detect the yawning motion of the mouth, contour finding algorithm is used to measure the size of mouth. If the height is greater than the certain threshold. It means person is taking yawning. To evaluate the performance of the proposed system, system has been measured under different conditions like persons with glasses, without glasses, with moustache and without moustache for 20 days in different timings. The system performs best when the drivers are without glasses.

**3.1.7. Eye Blink Detection method**

Ahmad and Borolie proposed the Driver Drowsiness System based on non-intrusive machine-based concepts. The system consists of a web camera which is placed in front of the driver. Online videos as well as saved videos for simulation purposed are considered. Firstly, camera records the facial expressions and head movements of the driver. Then the video is converted into frames and each frame is processed one by one. Face is detected from frames using Viola-jones algorithm. Then the required features like eyes, mouth and head from face are extracted using cascade classifier. Region of interest on face is indicated by rectangles. Here the main attribute of detecting drowsiness is eyes blinking, varies from 12 to19 per minute normally and indicates the drowsiness if the frequency is less than the normal range. Instead of calculating eye blinking, average drowsiness is calculated. The detected eye is equivalent to zero (closed eye) and non-zero values are indicated as partially or fully open eyes. If the value is more than the set threshold value, then system generates the alarm to alert the driver. Moreover, yawning is also considered to generate the alert. Online and offline are videos are used for experiment which are performed on two different systems. The results show that the system achieves the efficiency up to 90%

**3.1.8. Eye Closeness Detection Method**

Khunpisuth creates an experiment the calculates the drowsiness level of driver using Raspberry Pi camera and Raspberry Pi 3 model B. Firstly Pi camera captures video and to detect face regions in the images, Haar cascade classifier from Viola-Jones method is used. Several images are trained in different lights. The percentage of 83.09 % is achieved based on the case study with 10 volunteers. Blue rectangle shows the Region of Interest (ROI) that is face. Again, Haar cascade classifier is applied on the last obtained frame which reduces the size of ROI. After the face detection, drowsiness level is calculated using eye blink rate. Eye region is detected using template matching on the face and authors uses three templates to check the eye blink and aye area. CV\_TM\_CCOEFF\_NORMED from OpenCV is considered as it gives improved results than other methods of template matching. The integration of eyes and face detection permits the checking of an eye blinking and closeness rate. If the eyes are closed, then the value of closed eye is higher than the open the eyes and opposite case if eyes are open. Authors assumed that Haar cascade classifier will work if the face is front facing position. That why authors proposed the method to rotate the tilted face back in to the front-facing position. Firstly, determines whether the head is tilt or not then calculates the degrees of rotation (angle). After the accurate detection of face and eyes, drowsiness level of driver is determined. If the drivers blink eyes too frequently, he system indicates he drowsiness. When the level reaches to one hundred, a loud sound will be generated to alert the driver.

**4. Modular Division:**

The entire architecture is divided into 6 modules.

1. Face Detection

2. Eye Detection

3. Face Tracking

4. Eye Tracking

5. Drowsiness Detection

6. Distraction Detection

Face Detection: This module takes input from the camera and tries to detect a face in the video input. The detection of the face is achieved through the Haar classifiers mainly, the Frontal face cascade classifier. The face is detected in a rectangle format and converted to grayscale image and stored in the memory which can be used for training the model. Eye Detection: Since the model works on building a detection system for drowsiness, we need to focus on the eyes to detect drowsiness. The eyes are detected through the video input by implementing a haar classifier namely Haar Cascade Eye Classifier. The eyes are detected in rectangular formats Face Tracking: Due to the real-time nature of the project, we need to track the faces continuously for any form of distraction. Hence the faces are continuously detected during the entire time Eye Tracking: The input to this module is taken from the previous module. The eyes state is determined through Perclos algorithm. Drowsiness detection: In the previous module the frequency is calculated and if it remains 0 for a longer period then the driver is alerted for the drowsiness through an alert from the system Distraction detection: In the face tracking module the face of the driver is continuously monitored for any frequent movements or the long gaze of the eyes without any blinks which can be treated as lack of concentration of the driver and is alerted by the system for distraction.

**5. Testing**

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, subassemblies, assemblies and or/a finished product. It is the process of exercising software with the intent of ensuring that the software system meets its requirements and user expectations does not fail in unacceptable manner. There are various types of test. Each test type addresses a specific requirement.

**Types of Tastings**

**5.1. Unit Testing**

Unit testing involves the design of test cases that validate the internal program logic is functioning properly, and that program inputs procedure valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application. It is done after the completion of an individual unit before integration. This is structural testing that relies on knowledge of its construction and is invasive. Unit test perform basic test at component level and test a specific business, application and/or system configuration Unit test ensures that each unique path of princess performs accurately to the documented specifications and contains clearly defined inputs and expected results.

**5.2. Integration Testing**

integration tests are designed to test integrated software components to determine if they actually run as one program. Testing in event driven and more concerned with the basic outcome of screens or fields. Integration test demonstrate that although the components were individually satisfaction, as shown successfully by unit testing the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination, of components.

**5.3. Functional Testing**

Functional test provides systematic demonstrations that function tests are available as specified by the business and technical requirement, system documentation and user manuals. Functional testing is cantered on the following items: Valid input: identify classes of valid input must be accepted, Invalid Input: Identify classes of invalid inputs must be rejected, Functions: Identified be exercised identities function must be exercised, Output: identify classes of application outputs must be exercised, Procedures: interfacing systems or procedures must be invoked. Organization and preparation of functions test is focused on requirements, key functions or special test cases. In addition, systematic coverage pertaining to identify business process flow; data fields, predefined process and successive process must be considered for testing. Before functional testing is complete, additional tests are identified and the effective value of current test is determined.

**5.4. System Test**

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results an example on site testing is configuration-oriented system integration test.

**5.5. White box Testing**

It is a testing in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is used to test areas that cannot be reached from a black box level.

**5.6. Black Box Testing**

Black Box Testing a testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kind of tests must be written from a definitive source document, such as specification requirements document. It is a testing in which the software under test is treated as black box you cannot see into it. The test provides inputs and responds to outputs without considering how the software works.

**6. Testing of Application**

At the interface of application, we can see three tabs as follows.

* Inage detection
* Drowsiness detection
* Attendance

With the help of images which are present in the data base or from live web cam we can accesses the images. As soon as image is uploaded it checks the drowsiness of student with the help of calculating distance of the eyes true or false statement is provided for the drowsiness of student. In attendance sheet we get the drowsiness status of the student and time. With this application we can see student is active in the class or not.

**7.Conclusions**

The current study developed an automated system for detecting drowsiness of the student. The continuous video stream is read from the system and is used for detecting the drowsiness. It is detected by using haar cascade algorithm. The haar cascade algorithm uses haar features to detect face and eyes. Haar features are predefined are used for detecting different things. The haar features are applied on the image and blink frequency is calculated using perclos algorithm. If the value remains 0 for some amount of time then it detects as sleepy and alerts driver by activating an alarm. If the value remains constant for longer periods then the driver is said to be distracted then also an alarm is activated.

**8.References**

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