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Automatic Analysis System For Students Behavior In Online Classroom

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Abstract. Student activity plays a crucial role in the learning process, either in the e-learning environment or in classroom. We use agitation, disruption, shifting pattern of head posture, facial expressions and eye concentration to conclude meaningful information of the student when engaged in an e-learning circumstances. Our method focuses on recognising and estimating student activities during class time. In this paper introduced the automatic analysis system and the computer vision techniques to track student's classroom activities. A multi-task cascade convolution neural network (MTCNN) automated analysis system is proposed that is capable of monitoring student behaviours and performance. The proposed automatic analysis system provides students with a high, medium and low degree of attention during their learning environment. This system benefit both the teacher and the students, so that teacher can trace the student's interest in a specific subject. The proposed automatic analysis system is evaluated to detect head movement, eye rotation and facial perception and attention level of student focus in the classroom. Results shows that proposed system has higher accuracy.

Keywords: E-Learning environment, Face Detection, and Recognition, Eye gaze, Head Pose estimation.

1. INTRODUCTION

Student interactions plays a significant role for accessing the interest of the learner in class room. The different types of human face indicate that he/she is interested in learning or not. Student activity plays a crucial role in assessing student engagement in the learning environment. In traditional days, teachers teach in classroom that is easy to observe and their interest in learning, although in recent days, the digital e-learning environment has been fostered by new technology. The main difficulties in the e- learning conditions are the tracing of student's emotions in learning process. In the e- learning world,the level of interest in learning the student subject is lacking. Also an important and fascinating subject will often be boredom for students. Thus the hard work of teacher become useless. Student engagement [1] and interest rely on a number of factors.One major factor is the teacher whose positive feelings makes the student engaged and involved in listening to the subject. The size of the classroom is another factor that affects the student attention. In larger classes, the teacher needs more time to attract the attention of the student, where the student receives the right talk from the teachers in a small space. Latest study reveals that only 46 percent of students

are listening class with interest. This shows that half of the students in classroom are not showing up interest in learning environment. It is important to analyse why the students are lose their interest in learning, in which situation they lose their interest in subject, etc. Thus the analysis allows the teacher to know where the material of interest is lacking and then they can fix it, making the students more effective in learning. Researchers [2] pointed out that students are distracted by playing video games, watching you tube videos, movies or talking with friends while teaching on digital devices are impaired by long term memory, as the result student performance is poor in academic side. Mentality of students are they can do multitask at a time but it's a myth. The authors [3] finds that talking with friends during class time impacts students daily focus regularity in classroom .As well this will become as habit for students. As a result the student performance is at a low level. To follow up the activities of students survey approach and quizzes can be taken but these two approaches are not valued because students will have forgotten what they learned or not in e-learning environment[17]. The advancement of computer vision technology the camera are placed in spotted locations in classroom where the students are covered so that the emotion of students can be captured and processed and thus teachers can use these data to change their behaviours in teaching process as well can start asking questions to students to keep them active in their classrooms. Face emotions plays a crucial role in interaction of student with teachers. Feelings are shown out in face, eye movement[18]. This review is focused on face detection, eye gaze detection, head post estimation .facial features are detected through face detection technique[4]. The facial features are used not only for emotion recognition but also for face recognition. Significant component is that the identification process is accurate because we cannot give a good student the wrong details[5]. And thus we proposed an automated analysis system with MTCNN consisting of classroom tracking techniques and displaying the outcomes of the activities.

2. RELATED WORK

This section provides literature reviews on Face Detection, Eye Tracking, Head Position Extraction are used to analysis the student behaviour and activities in the class room.

Face Detection and Face Alignment

Face recognition and face alignment are two most important approaches of monitoring the students in classroom environment [1]. Assigning an interesting level to wrong student is fair and thus Proper recognition of student's attention level is very important. Some research work [5] concluded that the detection of emotion from face expressions is easy and can predict six different emotions with 89% of accuracy [6]. In [7] authors proposed a technique that detect a facial expression that reveals the boredom level of the student. Convolutional neural networks produce stunning advances in computer vision, such as classification of images and face recognition [8]. The great success of CNN in computer vision, numerous research methods have also used these deep convoluted neural networks for facial detection. The author [9] established deep convolutional neural networks for facial parameter recognition for high response score in face regions, which generate windows for the pupil. Although this approach is too complicated to implement, it is also costly to use in actual applications. The author [10] use cascaded CNNs for face detection, as it requires bounding calibration from face detection with more computational resources and also avoids inherent association between facial landmarks localization and bounding box regression.

Eye tracking

One of the significant factor that comes to mind to analyse the student's emotion is their eyes. The author [11] tabrizi suggested a technique to evaluate the number of pixels in the near and open state of the eye [12]. To detect drowsiness, the number of open or close degree of eyelid is used. In order to detect the location of the eyes and figure out whether the eye is closed or open,the author zhang used vertical projection technique [13]. Zhu uses filter technique to route the eyes and extract the parameters of the blink duration [14]. The above techniques assess the focus of student's emotions through eye tracking.

Head Position Extraction

In the paper [15], the author has shown that head orientation is a effective technique for calculating students interest percentages in the classroom. The author's focus has hit 88.7% precision. The demonstrated a head pose estimation algorithm by matching the 3D coordinates of the facial landmarks. In [16][19] Cao suggested an estimate of real-time multiperson 2D pose. The input image is fed to Convolutional neural networks to analyse and predict a 2D range of face pieces. Open pose average precision takes the head pose on the basis of a multi-person data test. With this face pose calculation, the emotions of the students can be measured. The head position of the students can be evaluated by using this head pose, which presents the level of concentration of students involved in the learning environment.

3. METHODOLOGY

This section discussed the Multi task cascade convolution neural network (MTCNN) and automatic analysis system with MTCNN for monitoring student's classroom activities. In fig1 presented overall diagram for automated analysis system.

Multi task cascade convolution neural network (MTCNN)

Researchers are currently motivated to demonstrate interest in face alignment[8]. The face alignment field is divided into two main groups of prototype fitting and regression-based. Author kaipenz zhang suggested the multi-task cascade convolution neural network(MTCNN) for facial recognition[8]. The proposed framework has three stages. In stage 1(P-Net),Candidate windows are easily generated by a shallow cascade convolution neural network as obtained by bounding box regression vector.In stage 2(R-net),it refines the windows by denying a significant number of false candidates by bounded box regression and a more neural convolution network. In stage 3(O-net), it uses a more efficient convolution neural network to re-energize the face region with more supervision and to generate five facial hallmark positions. In MTCNN the image is created as multiple copies in various sizes and check for different size faces inside the image.After going through the image, several scaled copies of the image are created and transfer it to the first neural net-P-net and collect its output.To filter the output of the P-net a list of confidence levels for each bounding box is gathered and deletes the boxes with lower confidence. After selecting the boxes with higher confidence, the coordinate system is standardised to translate all the coordinate systems to the actual unscaled image. Finally a non-maximum suppression method is use to limit the number of bounding boxes. Thus the bounding box coordinates are translated to the real image coordinates.

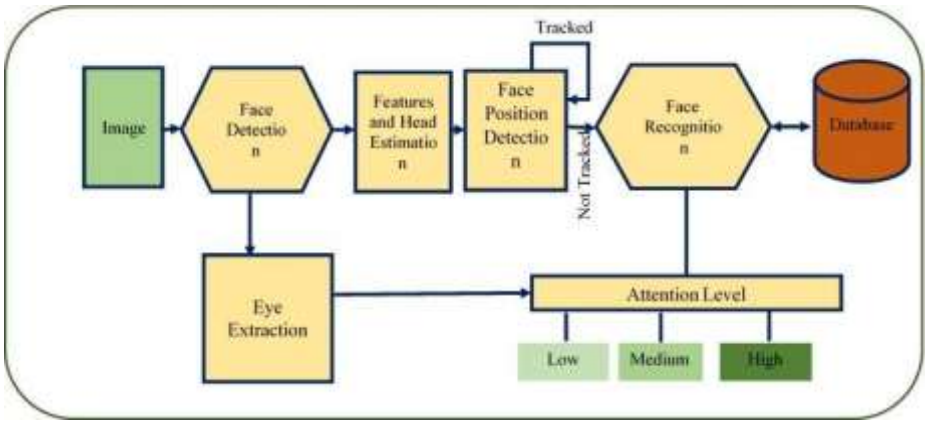

Fig. 1. Work Flow Diagram

Proposed Automatic Analysis System with MTCNN

The proposed automatic analysis system is designed to know the attention level of the student through constantly tracking headmovement, eyerotation and facial perception. After the facial features have been identified, it will evaluate the student focus on teacher visual-content. The student images are taken from the camera and preprocessed to be denoised, resized and transferred to a grayscale for further processing. Using the Multi Task cascade convolution neural network algorithm, the student's face is identified and then 101layers of Resnet convolution neural network is used recognize the student faces. The location of the eye is inferred from the students frame and then the area of the eye and status of the eye is established. Head rotation is marked by the identification of whether or not both eyes are apparent. If the eyes are not clear, this means that the head is tilted in a different direction.And ultimately, this automatic system analyses student focus using low, medium and high concentration. The student eye as well as the face are in correct location towards the camera then it indicates that the student is engaged in listening to the subject and thus is shows high concentration level of attention. If the one eye is noticeable, this means that the student is not facing the monitor properly and the focuslevel is offered a medium level. When student head pose is not noticeable for a long time, the student is not involved in the subject and thus its shows the low concentration level of attention. The analyzed faces and level of attention of each student are stored in database as a unique id is assigned for each student from which the teachers can access the level of attention of the student. Thus the proposed system helps teachers to trace the student's interest in a specific subject.

4. RESULTS AND DISCUSSION

The Experiments were conducted in MATLAB platform. Multi task cascade convolution neural network (MTCNN) and automatic analysis system with MTCNN are evaluated on the gathered video database. The performance evaluation of the proposed method automatic analysis system with MTCNN is compared with previous methods in terms of average recall, precision and accuracy. The evaluation parameters used average accuracy is the proportion of true results (both TP and TN) among the total number of examined instances. The best accuracy is 1, whereas the worst accuracy is 0. It can be computed by formula:

Accuracy (%) = (TP + TN) / (TP + TN+ FP + FN) *100 (1)

Where TP the true positives, TN the true negatives, FP the false positives and FN the false negatives.

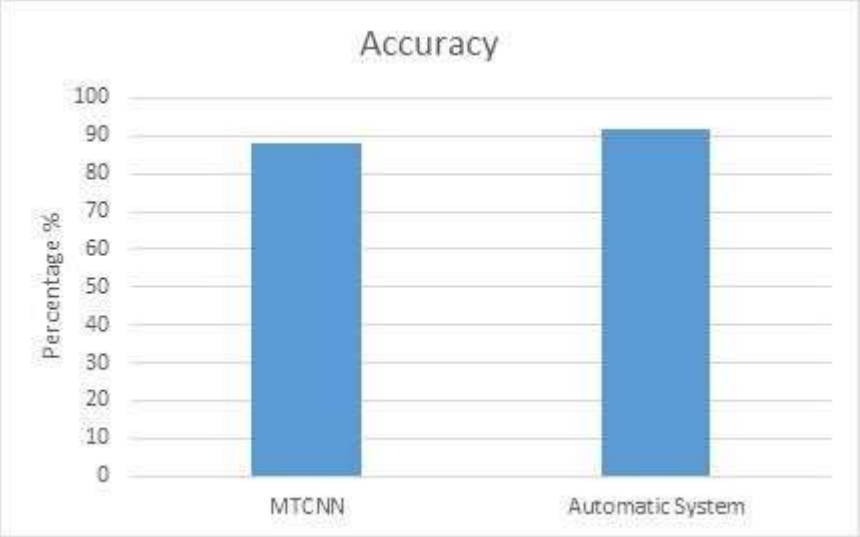

Fig. 2. Average Accuracy

The proposed automatic analysis system is evaluated to detect head movement, eye rotation and facial perception and attention level of student focus in the classroom. Results shows that proposed system has higher accuracy.

5. CONCLUSION

The automatic analysis system is proposed using an MTCNN algorithm for image processing. It has the ability to track the online learning environment through a camera, which gives feedback to teachers about how students pay attention in their classroom. The teachers could also use this feedback to improve their teaching approach to improve the student attention level and to inform students about their classroom behavior. This system is effective enough to identify negative feelings such as boredom in the e-learning environment. The proposed automatic analysis system is evaluated and Results shows that proposed system has higher accuracy.

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