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Research Article

Biometric Based E-Learning Application To Detect Learner Attention Prediction

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ABSTRACT

Dynamic student's attention monitoring in the class rooms, online study is essential. Existing model fail to predict the student attention, understanding, engagement automatically using biometric features. Current traditional system is manual with less efficiency and time consuming. Even in both class room based traditional education, e-learning systems, dynamic learner behaviour is not considered. To address this problem statement, this survey paper explores how dynamic learner behaviour of audience, students can be obtained using computer vision and machine learning techniques to predict the engagement level. This research paper also focus on an image processing with deep learning process of invoking, extracting biometric features from the students and detect students attention, distraction towards the class and based on the result outcome the proposed system recommends theory and video based content to obtain the attention back. For deep learning model, we use Convolutional Neural Network (CNN) for training the input models.

KEYWORDS — IMAGE PROCESSING, BIOMETRIC, DEEP LEARNING

INTRODUCTION

Usually during learning, students might lose their focus easily due to many reasons which can be personal, environmental [1]. Existing system majorly focus on performing assessment after the training. In this approach, the results are not satisfactory as it doesn't analyze the real time dynamic learner behavior during the training. Many research states the learners get pivoted or distracted from the class because of personal and environmental factors. The student attention is been asked manually by the teachers and there is no efficient system invoking image processing and deep learning techniques to detect the student, learner attention. In this paper, the learner response towards an online platform, traditional class room the learners are grouped in different groups based on the engagement parameters. Different teaching model is been delivered to both the groups to gain the attention.

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The current approach is time consuming and less efficiency. Many papers on e-learning has stated and proposed biometric based student engagement prediction.
Few research articles state human pupil can be used to identify human attention and distraction with rendering promising results [2]. Thus addition of few more biometric features such as human face based emotion, human pupil detection, human head movements can render accurate results and also this can enhanced as a product with CCTV camera and fixed in the class rooms. Thus this paper theoretically explains that based on the biometric features, the proposed system can predict learner behaviors such as distraction, stress, mental illness, tiredness, drowsiness etc.

As the whole world is shut down because covid19 virus, the complete school and college education is practiced online. Since the students, learners are been exposed to new education practice, thus prediction of students attention towards the tutor is very essential.

Fig 1 states few learning patterns in which tutors are involved addressing single or multiple audiences. In many approaches two way communicationis needed to predict the engagement and understanding level.

Fig 1. Learning Patterns

RELATED WORK

[3] This paper explains that both teachers and students can exchange the information's in a shared screen within the computer. Both the server and client systems can exchange information's within a shared screen by connecting directly using VNC. This system is not adoptable as it involves much efforts for the teachers to provide one to one approach and cost, time also increased. This system is
not an efficient solution for e-learning system.

[4] This paper explains e-learning platform where human pupil is used and features are extracted to obtain useful information for analysis. This could provide useful information's about the student mental mood for learning. This paper has used 500 video dataset for eye movement analysis. But this paper has used only fixation duration and blink rate parameters for eye tracking.

[5] This paper explains analyzing the facial parts from the audience can help in predicting the mental state. The facial parts can be eyes, nose, mouth, head etc. Analyzing biometric based features help is obtaining promising results. The authors briefed the process of obtaining eye features from the facial images. For meaningful feature extraction, they have used hough transformation technique. Finally for the classifier model, they have used support vector machine (SVM) algorithm for classification.
[6] In this paper, they explain the different techniques and process utilized for performing eye movement identification. Several algorithms are been compared to predict the performance. For the experimental results, the face image datasets are been obtained from the BioID database. For the result test bed, they have used external webcam which is associated to the system for obtaining the end user real time eye movements. But this paper failed to explain practical approach in detail.

[7] This paper explains human biometric based facial emotion detection system. The effective features which can be obtained from the human are noise, occlusion, various poses, eye movements. Occlusion is a current research area for detection of emotions from the occluded images.

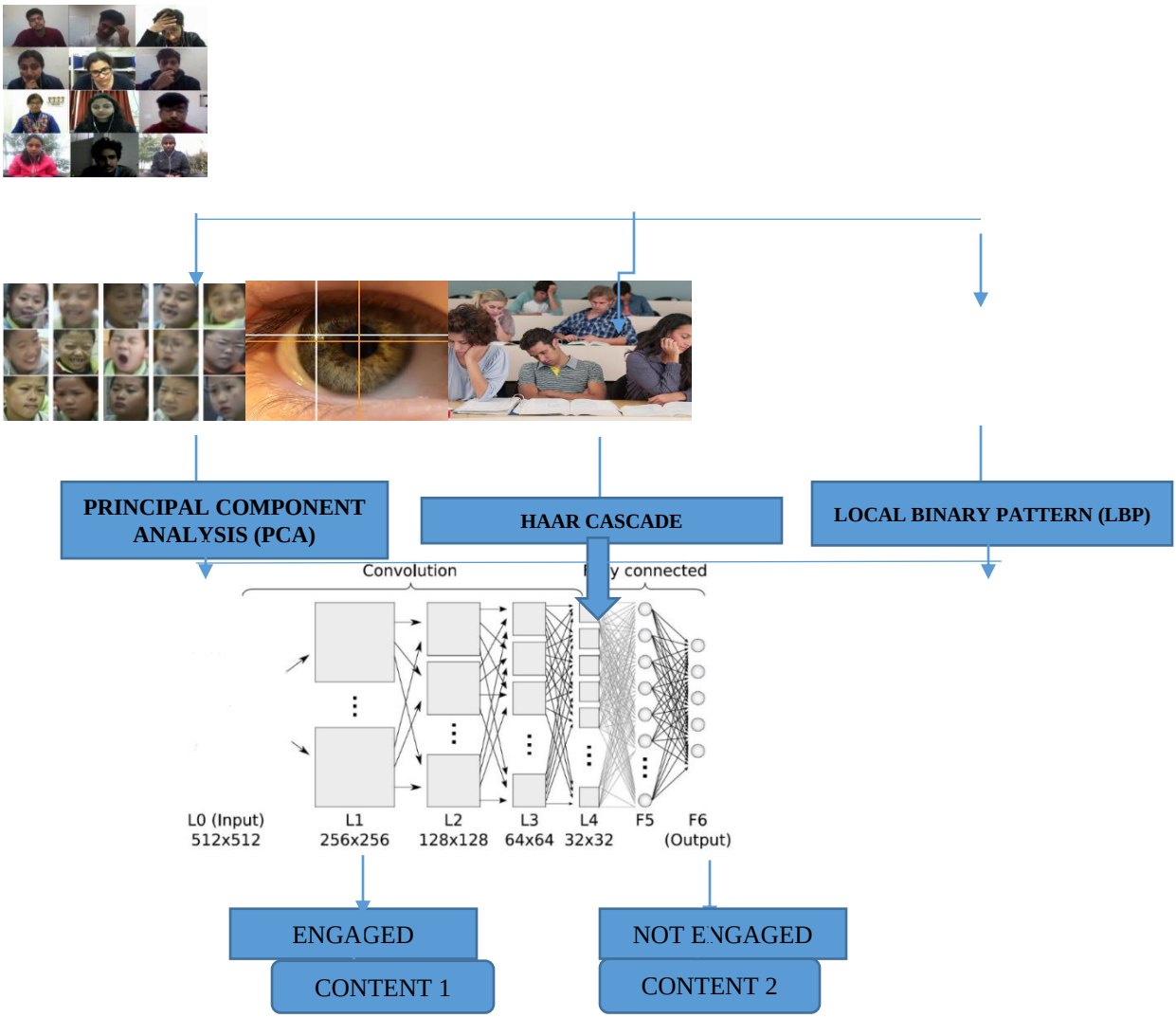
[8] This paper proposes an system to detect human emotions in real time with 70% accuracy. This system considers only three type of emotions which are negative, positive and blank emotions. Human mental state emotions are missed to obtain and analyze. Local movement detection is been used for feature extraction. For machine learning approach support vector machine (SVM) is been proposed for predicting the emotions.

[9] This paper proposes head movement tracking based learner engagement detection based on hardware and software systems. This paper for experimental test bed has utilized real time dataset sample size of 40 infants (16 are boys and 24 are girls). Features are extracted and machine learning technique is applied to predict 2 head movements such as left and right. This paper missed to predict up and down head gesture patterns.

From the literature survey, we figure out below issues,

Efficient e-learning system can be implemented using biometric features to predict the effectiveness of the learner. The system should be fixed a threshold value to change, modify the learning content based on the value obtained. The image acquisition can be obtained from real time and dataset video, images and subjected to pre-processing and feature extraction techniques. The machine learning algorithm plays an important role in building the classifier model to train and predict the concentration level of the learners towards the learning content. Integration of efficient feature extraction techniques and convolutional neural network provide promising results with better accuracy. The convolutional neural network training model gets modified, trained based on the input, thus providing flexibility and high accuracy. An efficient e-learning, classroom system to detect learning engagement, understandability, we can integrate 2-3 biometric features such as head, eye and facial emotions. Thus three different feature extraction algorithms can be used to extract the useful information’s from the input videos, images. Therefore, it is a challenge for the users to decide which algorithm can be adopted for the given set of data for analysis and producing efficient outputs.

PROPOSED ARCHITECTURE



PROPOSED METHODOLOGY

The proposed methodology predominately focus on dynamic student attention and distraction detection using multiple biometric features and teacher can able to get dynamic feedback of the learners. The proposed system can be applied to both classroom and online platforms. To address the technical challenges and disadvantages, this system used multiple biometric features for analysis and render promising results. In this system, biometric features such as face emotion recognition, human pupil detection and head movement detection. Thus this hybrid architecture provides promising results with dynamic change of learning content. Feature extraction algorithms such as Principal Component Analysis (PCA) for emotion detection from face, Haar Cascade for human eye movement prediction, Local Binary Patterns for identifying head movements. The proposed system uses convolutional neural network for training the model.

Thus deep learning based efficient CNN model render promising and accurate results. For experimental analysis, we have developed python based script in PyCharm tool.

EXPERIMENTAL RESULTS

emotion=emotion()

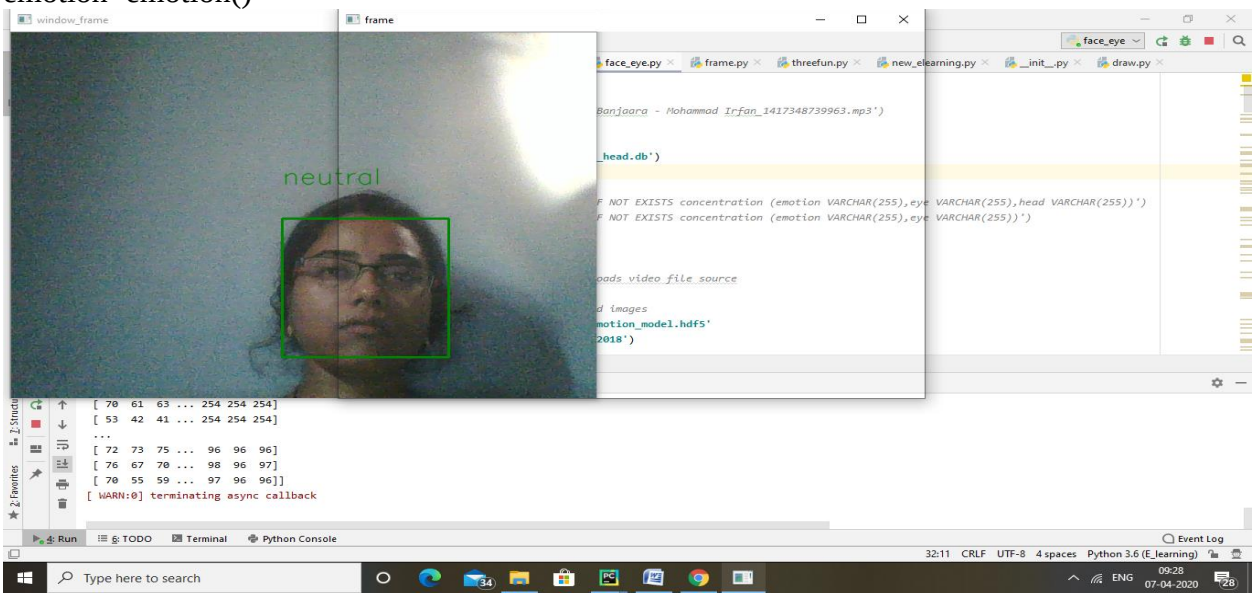


Fig 2. Real time facial emotion recognition – Neutral state

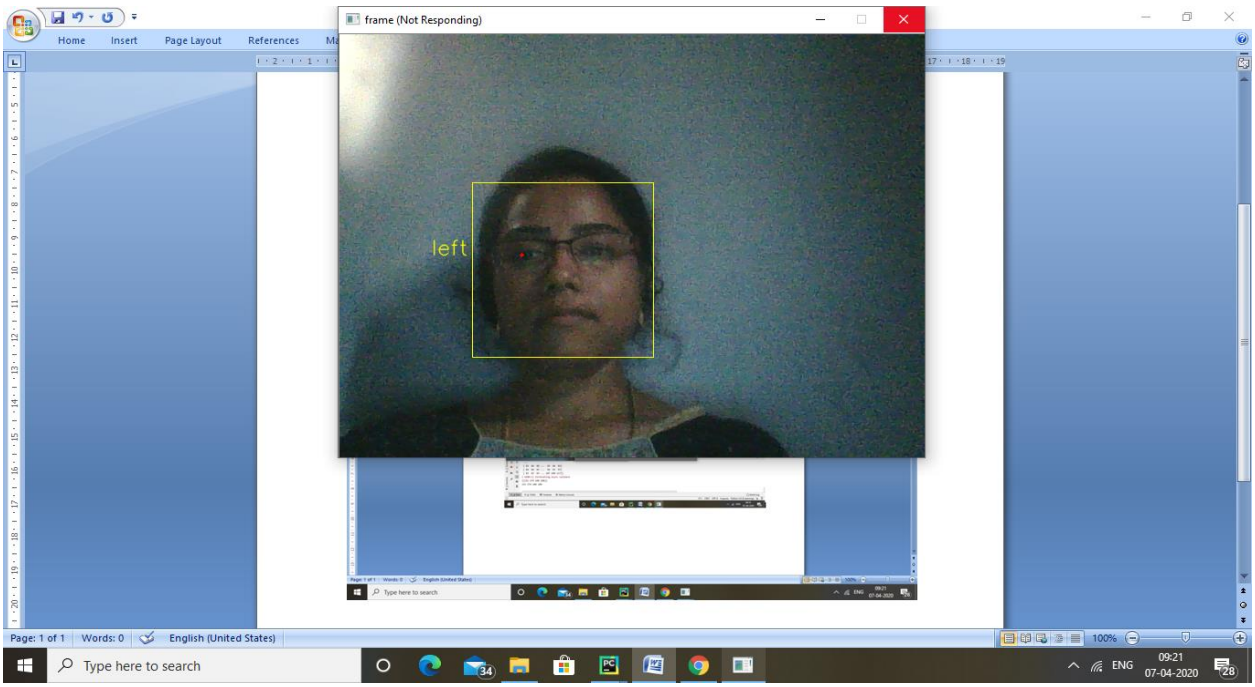


Fig 3. Real time Eye gaze detection and recognition –Left

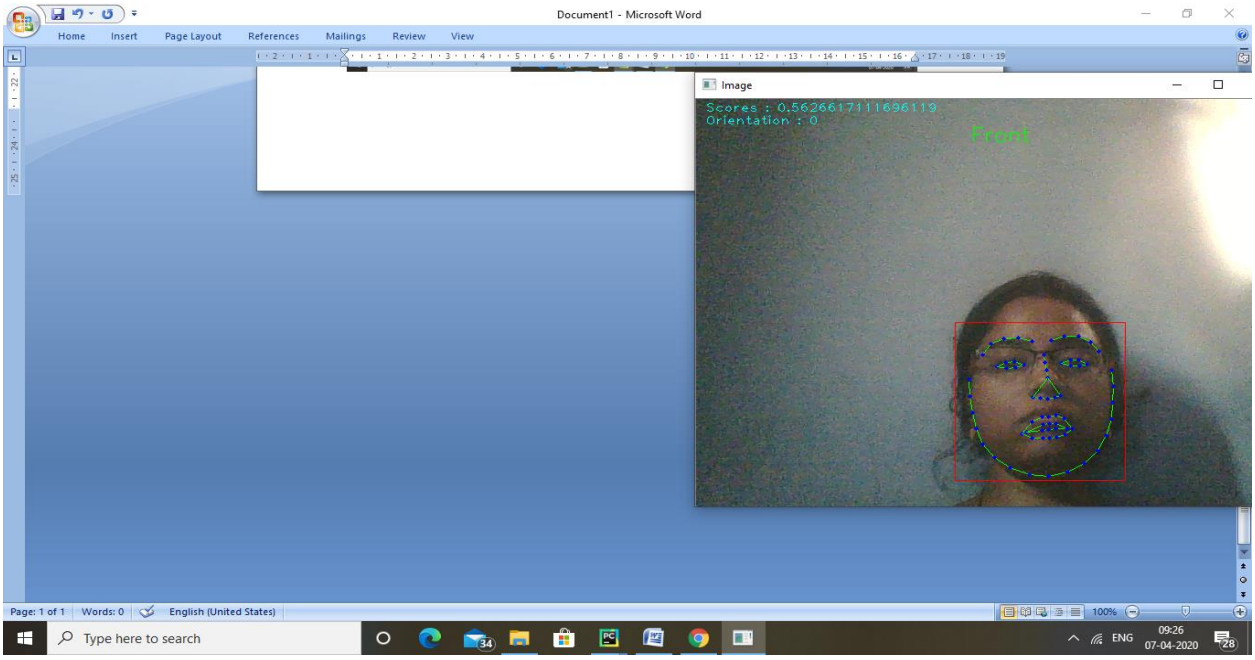


Fig 4. Real time face movement recognition – Front

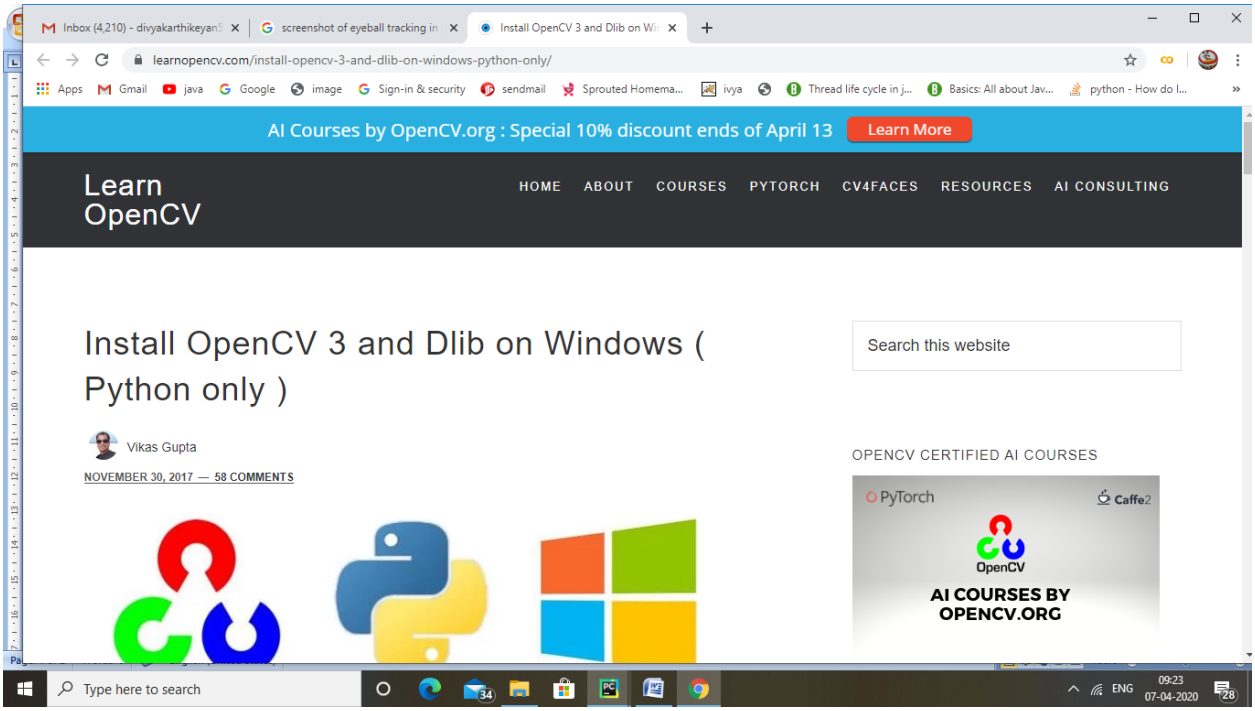


Fig 5. OpenCV for machine learning technique

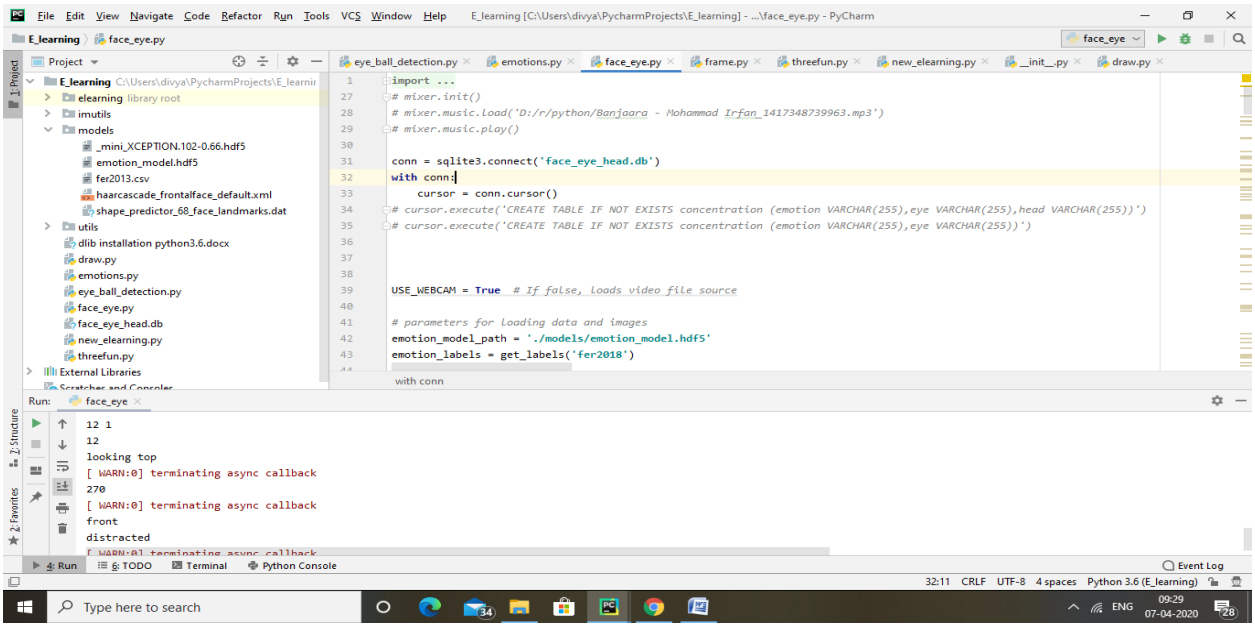


Fig 6. Python environment for development

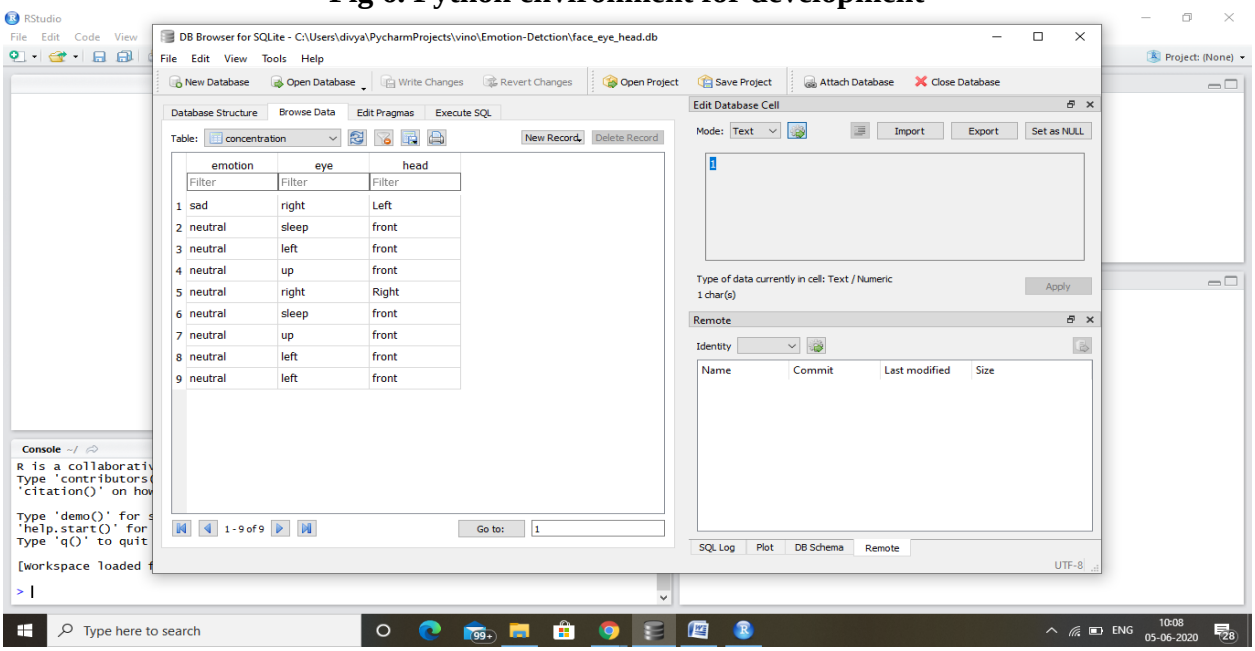


Fig 7. Input analysis

CONCLUSION

Predicting low-engagement students is important in classroom / e-learning systems because it allows teachers to understand the behavior of students and engagement towards the course. This paper explores various research papers related to e-learning technique. The survey of papers state that integration of biometric based e-learning system would be an efficient tool to predict dynamic learner behaviors during the training itself. Thus hybrid system invoking 2-3 biometric

features to predict learner engagement can an effective new tool for prediction of audience behavior dynamically and effectively. Thus through the biometric based learner feature extraction and application of machine learning technique can change the deliverance by dynamically analyzing the learner attention level. This would bring a revolution in the education sector. For experimental results, convolution neural network can be used for training the model with rendering promising results.

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