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Students Attention and Engagement Prediction Using Machine Learning Techniques

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Abstract— Real-time student engagement tracking is an important step towards education. Current approach doesn't consider student engagement detection using biometric features. In this project, we propose a hybrid architecture invoking student's eye gaze movements, head movements and facial emotion to dynamically predict student attention and engagement level towards the tutor and based on the output value the content is changed dynamically. Hence this concept has a huge scope in e-learning, class room training, analyse human behaviour. This project covers main process like Eye Ball, facial emotion and head movements Human Beings. For feature extraction step, we used Principal Component Analysis (PCA) for facial emotion recognition, Haar Cascade for pupil detection and Local Binary Patterns for recognizing head movements and OpenCV for machine learning model generation and comparison.

Keywords — Eye gaze, head movement, facial emotion, machine learning, Haar Cascade, PCA

1. INTRODUCTION

In a learning environment, learners can lose motivation and concentration easily, especially in a platform that is not tailored to their needs. Our paper is based on studying learner's behavior on an online learning platform to create a system able to clustering learners based on their behavior, and adapting educational content to their needs.

Few research papers states eye tracker can be of a solution but this approach can provide promising result all the time. Hence analyzing facial emotion, eye gaze movements and head movements can provide promising results at all the scenarios. Thus this paper introduces the use of biometric features to track and analyze the learners' behavior dynamically such as attention, stress, tiredness, drowsiness etc.

In the existing learning environment, learners can get diverted on many times due to many reasons. So there is no such machine learning system to predict learner attention and engagement dynamically and change the teaching delivery accordance to the output. This research paper, focus on predicting learner's behavior towards an online learning platform and traditional class room platform and cluster the learners count based on the engagement parameters and change he teaching deliverance based on the engagement level.

As because of the covid19 everything is happening online. Identifying students understanding is very important. Also the education cost (fees, tuition fee, day to day living expenses) also been increased tremendously.

From identification of where on the screen a user is looking, substantial value can be obtained. The main aim of our project is developing a technique of eye gaze detection, facial emotion and head movement which is evolved from interest in a novel interface for laptop computers. This interface would offers a user to control the computer through observing the features of interest and expresses action by blinking eyes.

This technology is beneficial for detection of fatigueness, surveillance, human computer interaction, advertisement etc.

2. RELATED WORK

[1] Designing a wheelchair is dealing with a thought of blending emotions with technology of unbeatable standards. The essence of scientific advancements is purely put through vigorous thought process considering and exploring all the available possibilities. Manually operated wheelchair; helping the physically challenged in their mundane life made their work dogmatic. Therefore, being an engineer, it is a task of elephantine proportions to put forth some of the technological developments which can render flexibility and robustness for the endemics. Hence, the ideas to make an "AUTOMATED WHEELCHAIR" which can be regulated by EYE-BALL movement. So an individual can control his/her wheelchair and can mitigate the dependency.

[2] In order to achieve high accuracy of face recognition, detection of facial parts such as eyes, nose, and mouth is essentially important. The authors explained the process to detect eye from the face images. They used Hough transformation for feature extraction of values from face images. Also for machine learning technique they have proposed support vector machine (SVM) algorithm for pattern identification.

[5] This research paper briefs different algorithms used for eye tracking. The performance of all algorithms are compared based on the human faces. The human face image dataset are taken from BioID database. In this the experimental results are processed using webcam and processed in real-time for analysis.

[6] The biometric images usually obtained in realtime would have noise, shadows, occlusions, pose variations, eyeblinks, etc. Occlusion is another research area. Thus this paper propose methodology for determining low resolution inputs within color spectrum. The authors performed their feature extraction algorithms IC in public database images like BioID, Gi4E for analyzing the efficiency and performance.

This research article explains the facial features like forehead, eyes, nose, mouth etc can be considered as the main attributes for analyzing facial emotion. The different types of facial emotion recognition can be identified using these main attribute. Thus based on this a model is generated to identify the expression on a human face.

3. METHODOLOGYY

Fig 1 explains our proposed e-learning architecture. In this 3 biometric features are extracted based on the user dynamic face input. Biometric features like facial expression, facial head movements, eye movements are analyzed and attention level Is predicted. Feature extraction and machine learning model are used for prediction.

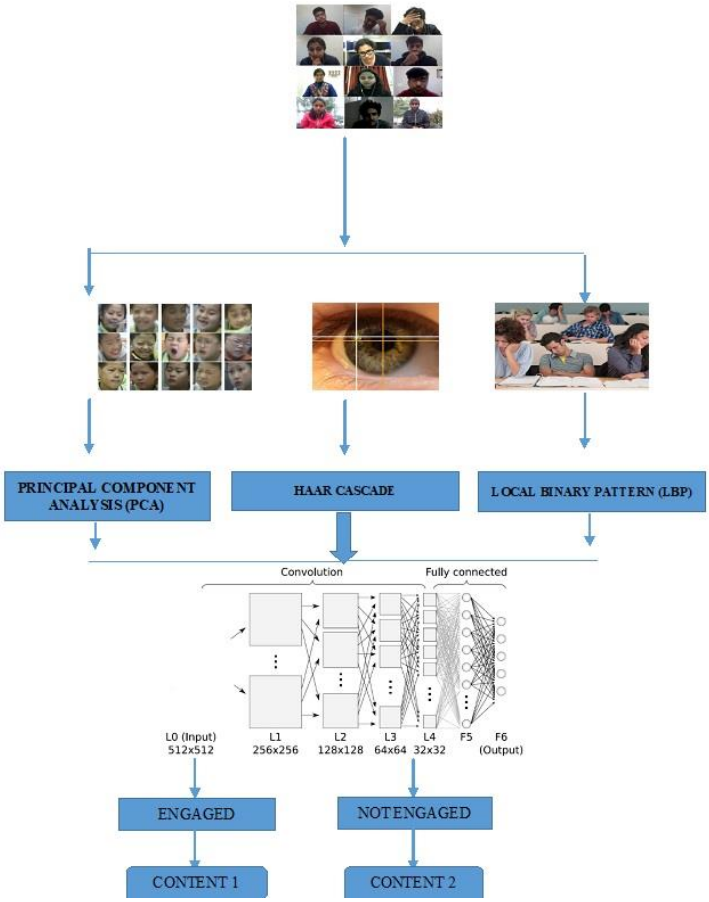

Fig 1. Methodology

The proposed methodology majorly focus on dynamic student behavior analysis is the first initiative to automate student attention / engagement and provide feedback about the teacher. Also provide student's feedback to the teacher. Our proposed system, is applied in both traditional / e-learning platforms. In the proposed methodology a hybrid architecture system invoking student facial emotion recognition, eye gaze monitoring, head movements identifications based analyzing dynamic student engagement / behavior in classroom and towards a specific course at e-learning platforms. Our proposed architecture uses feature extraction algorithms like Principal Component Analysis (PCA) for facial emotion recognition, Haar Cascade for pupil detection and Local Binary Patterns for recognizing head movements. For machine learning approach and to provide accurate results we propose Open CV. Experimental results are been implemented using Pycharm.

4. EXPERIMENTS AND RESULTS

Fig 2 explains the emotion detection from real facial image. Based on the feature extracted values and comparison with the trained values the facial emotions like neutral, happy, sad, anger, surprise is detected.

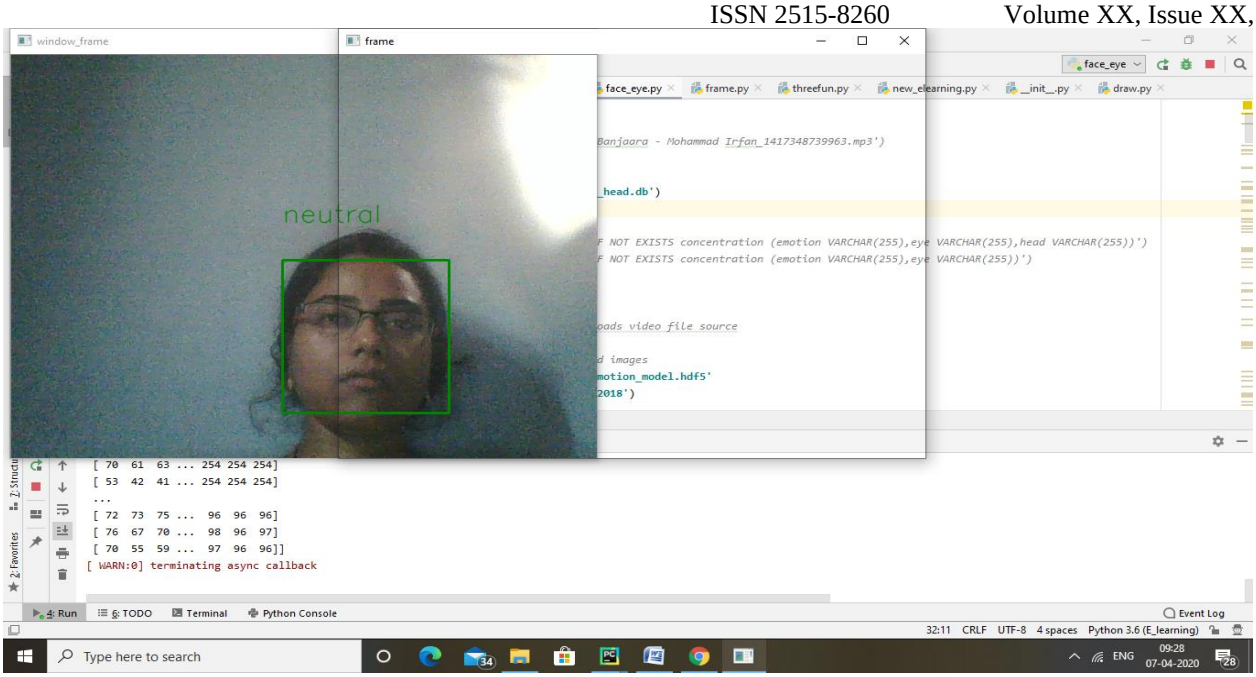

Fig 2. Real time facial emotion recognition – Neutral state

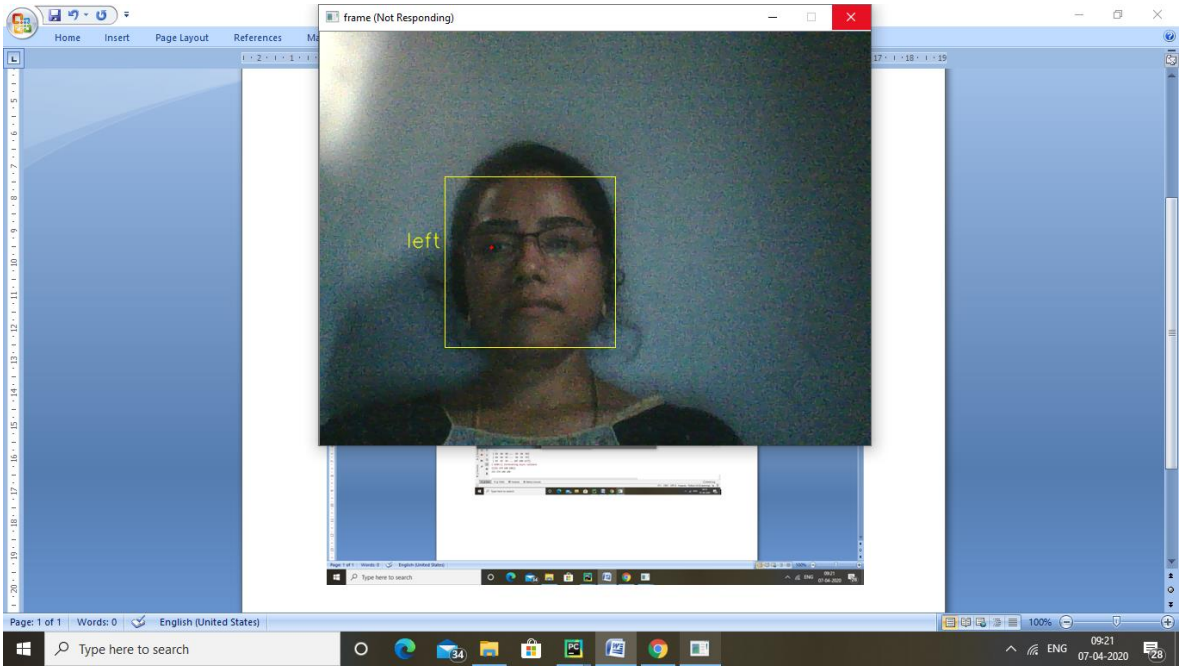

Fig 3. Real time Eye gaze detection and recognition –Left

Fig 3 explains eye movement detection from the input facial input image. Based on the feature extraction algorithm and trained classifier model, eye movements like left, right, top, bottom, neutral is predicted.

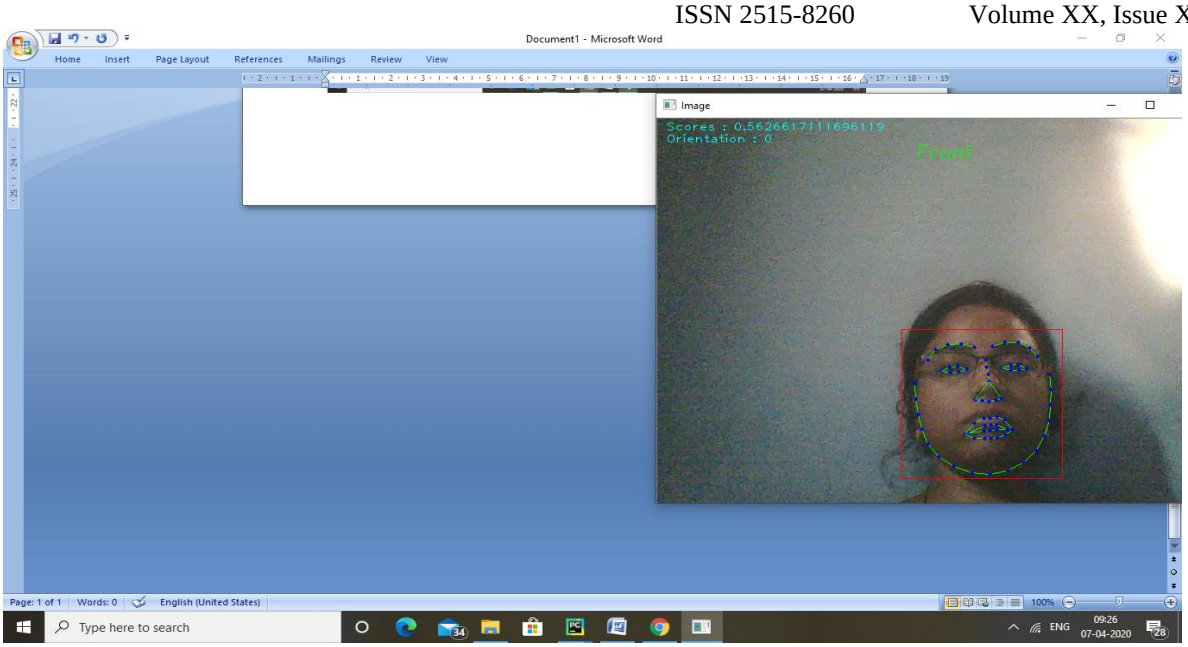

Fig 4. Real time face movement recognition – Front

Fig 4 explains face head movement detection from the input facial input image. Based on the feature extraction algorithm and trained classifier model, head movements like left, right, top, bottom, neutral is predicted.

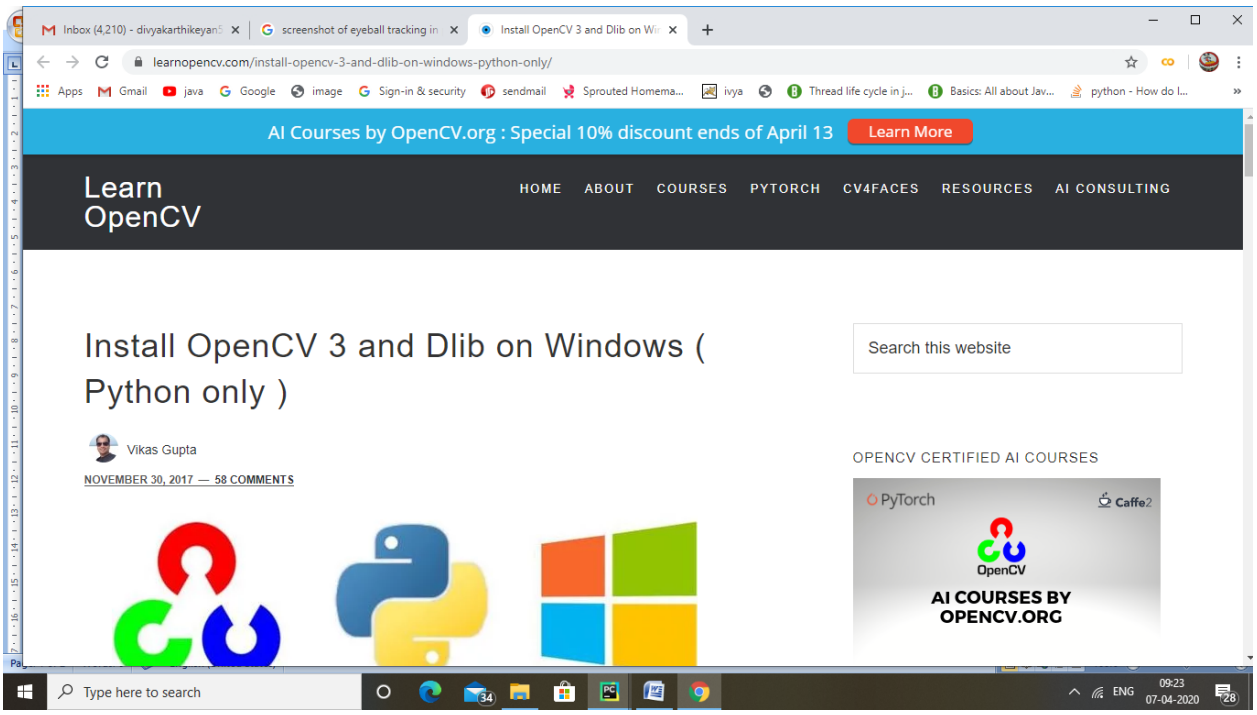

Fig 5. OpenCV for machine learning technique

Fig 5 explains the machine learning library used for training the model for detecting emotions, eye movements and head movements. OpenCV provides promising results during our experimental model development.

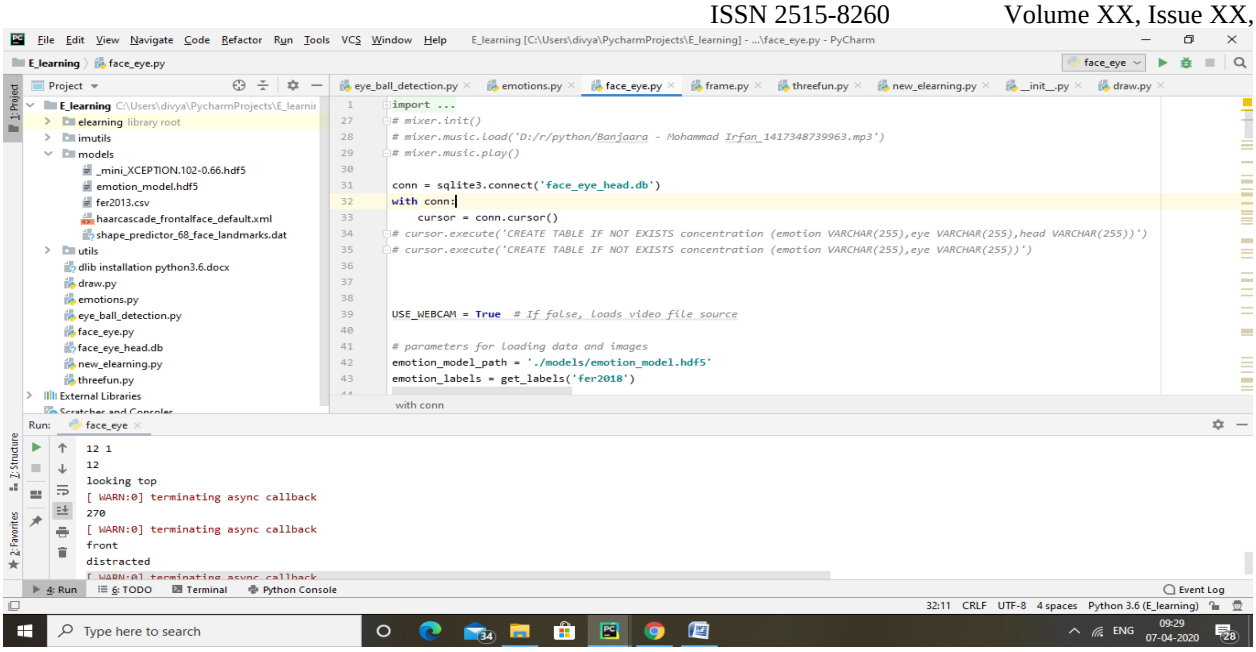

Fig 6. Python environment for development

Fig 6 shows the PyCharm tool environment used for experimental results. We have defined all modules like web cam initiation, pre-processing, feature extraction, machine learning classifier, weightage and learning content recommendation is performed using PyCharm tool.

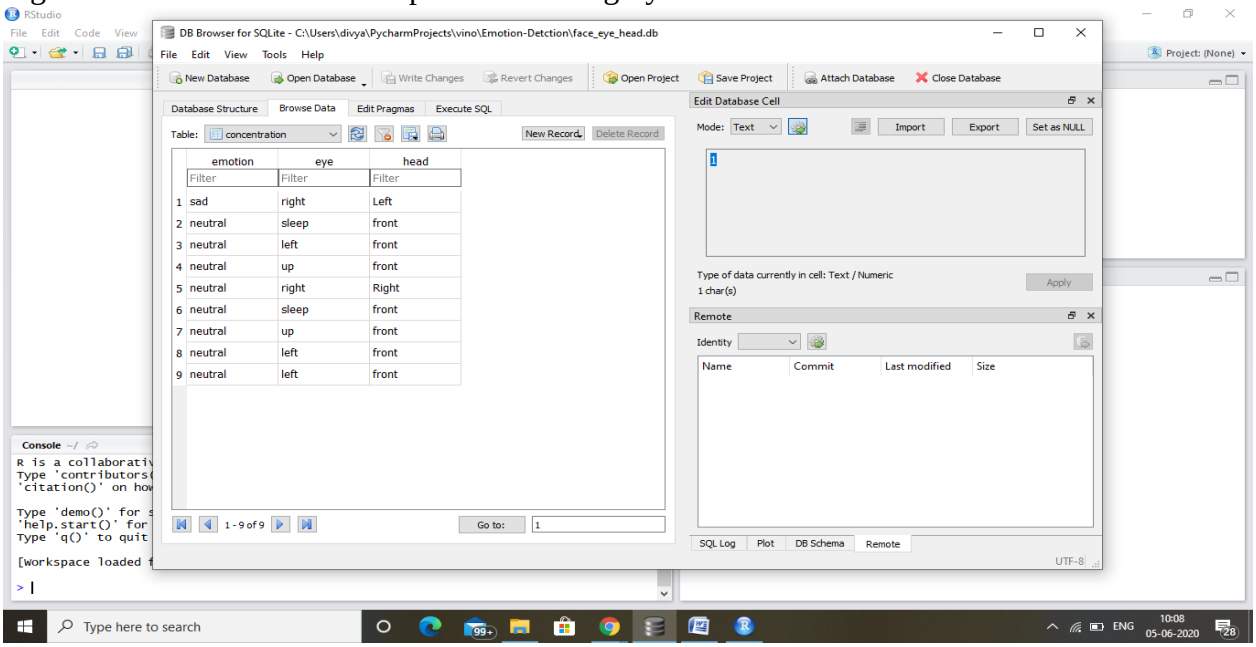

Fig 7. Input analysis

5. CONCLUSION

The hybrid biometric based learner analysis does appear to be a promising new tool for evaluating learners' behavior dynamically. This technology can provide many benefits to e-learning, such as facilitating adaptive and personalized learning. Thus through this proposed system, the tutor can change the deliverance by dynamically analyzing the learner attention level. This would bring a revolution in the education sector.

6. FUTURE WORK

In future, the performance of proposed method will be improved and will be extended for detecting the students fatigue by measuring the degree of openess of the eye. Further the real time implementation using

video camera will be conducted. Also this project can be extended in analyzing student head movements and students facial emotions.

7. REFERENCES

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