NEW FRAME WORK FOR E-LEARNING BY USING FACIAL EMOTION RECOGNITION AND EYE TRACKING MECHANISM

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Abstract - India always an important role in the global education. India is always considered as one of the largest network of educational institutions. Although several constraints are been associated with our learning system. In our system, we propose 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[6]. Our proposed architecture uses feature extraction algorithms like Principal Component Analysis (PCA)[12,13] for facial emotion recognition, Haar Cascade[14] for pupil detection and Local Binary Patterns for recognizing head movements. For machine learning approach and to provide accurate results we propose random forest algorithm based Open CV library. Experimental results are been implemented using Pycharm.

Key Words: Learning system, PCA, Haar Cascade, Open CV, Local Binary Pattern, Pycharm

1. INTRODUCTION

Thus dynamic student behavior analysis is a first step towards an automated teacher feedback tool for measuring student engagement. Our proposed system can be applied in both traditional / e-learning systems. In our system, we propose a hybrid architecture [6] system invoking student facial emotion recognition [10][11], 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)[12,13] for facial emotion recognition, Haar Cascade[14] for pupil detection and Local Binary Patterns for recognizing head movements. For machine learning approach and to provide accurate results we propose random forest algorithm based Open CV library. Experimental results are been implemented using Pycharm.

1.1 PyCharm

PyCharm is an integrated development environment (IDE) used in computer programming, specifically for the Python language. It is developed by the Czech company JetBrains. It provides code analysis, a graphical debugger, an integrated unit tester, integration with version control systems (VCses), and supports web development with Django.

1.2 Open CV library

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product,
OpenCV makes it easy for businesses to utilize and modify the code.

### 1.3 Haar Cascade

The appearance of inner eye corner exhibits insignificant variations with eye movements and blinks. Therefore, this paper proposes to use inner eye corners as reference points for gaze tracking. The eye corners can be located easily in the eye ROI. The vectors connecting eye corners and iris centres can be used to calculate gaze position. In this paper, we proposed a method by utilizing a sliding window and haar features, which the detection window starts from the center of the image which already indicates the area of eye to reduce the processing time and errors in eye detection. First, a `cv::Cascade Classifier` is created and the necessary XML file is loaded using the `cv::CascadeClassifier::load` method. Afterwards, the detection is done using the `cv::CascadeClassifier::detect MultiScale` method, which returns boundary rectangles for the detected faces or eyes.

### 1.4 Principal Component Analysis (PCA)

Principal Component Analysis (PCA) is a statistical technique used for dimension reduction and recognition, & widely used for facial feature extraction and recognition. PCA is known as Eigen space Projection which is based on linearly Projection the image space to a low dimension feature space that is known as Eigen space. Mathematically, a covariance matrix is a $p \times p$ matrix, where $p$ represents the dimensions of the data set. Each entry in the matrix represents the covariance of the corresponding variables. Consider a case where we have a 2-Dimensional data set with variables a and b, the covariance matrix is a $2 \times 2$ matrix as shown below:

$$
\begin{bmatrix}
\text{cov}(a,a) & \text{cov}(a,b) \\
\text{cov}(b,a) & \text{cov}(b,b)
\end{bmatrix}
$$

In the above matrix:

- Cov(a, a) represents the covariance of a variable with itself, which is nothing but the variance of the variable ‘a’
- Cov(a, b) represents the covariance of the variable ‘a’ with respect to the variable ‘b’. And since covariance is commutative, Cov(a, b) = Cov(b, a)

### 2. Unit Testing or Component Testing

In computer programming, unit testing is a software testing method by which individual units of source code, sets of one or more computer program modules together with associated control data, usage procedures, and operating procedures are tested to determine if they are fit for use.

<table>
<thead>
<tr>
<th>Test case no</th>
<th>Description</th>
<th>Pre-conditions</th>
<th>Pass/Fail</th>
<th>Expected results</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD_001</td>
<td>Place your pupil in front of cam</td>
<td>Cam analysing</td>
<td>Pass</td>
<td>Successfully analysed.</td>
</tr>
<tr>
<td>PD_002</td>
<td>Analyse the pupil.</td>
<td>User pupil</td>
<td>Pass</td>
<td>Successfully imported.</td>
</tr>
<tr>
<td>PD_003</td>
<td>Analyse the pupil movement</td>
<td>Motion of pupil</td>
<td>pass</td>
<td>Analysed successfully</td>
</tr>
<tr>
<td>PD_004</td>
<td>Movement of pupil are analysed</td>
<td>Movement of pupil</td>
<td>Pass</td>
<td>Successful</td>
</tr>
<tr>
<td>PD_004a</td>
<td>Pupil projection</td>
<td>Human Eye</td>
<td>Fail</td>
<td>Update of projection failed</td>
</tr>
<tr>
<td>PD_005</td>
<td>Recording of pupil motion</td>
<td>User pupil movement recorder</td>
<td>Pass</td>
<td>Imaging successful</td>
</tr>
<tr>
<td>PD_006</td>
<td>Perfection of pupil</td>
<td>Perfect projection</td>
<td>Pass</td>
<td>Projection successful</td>
</tr>
<tr>
<td>PD_007</td>
<td>Analysing of motion</td>
<td>Analysing the motion</td>
<td>Pass</td>
<td>Analysed successfully</td>
</tr>
<tr>
<td>PD_008</td>
<td>Display of pupil movements</td>
<td>Pupil movement</td>
<td>pass</td>
<td>Successfully displayed</td>
</tr>
</tbody>
</table>

Fig 1. Entity Relationship diagram
3. RESULTS

3.1 Face Detection

3.2 Emotion Detection

Fig 2. Face at front

Fig 3. Face at left

Fig 4. Face at right

Fig 5. Neutral emotion

Fig 6. Sad emotion

Fig 7. Happy emotion
4. CONCLUSION

The hybrid biometric based learner analysis does appear to be a promising new tool for evaluating learners' behaviour 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.

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