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FACIAL EMOTIONS RECOGNITION USING CNN

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Abstract
Nowadays, deep learning techniques know a big success in various fieldsincluding computervision. Indeed, a convolutional neural networks (CNN) model can be trained to analyze imagesand identify face emotion. In this paper, we create a system that recognizes students' emotionsfrom their faces. Our system consists of three phases: face detection using Haar Cascades, normalization and emotion recognition using CNN on FER 2013 database with seven type of expressions. Obtained results show that face emotion recognition is feasible consequently,itcanhelptomodify theirpresentation accordingtotheemotions.

Keywords:—facial expression, Emotion recognition , Convolutional neural networks(CNN),Deep slearning, Intelligent system

1. INTRODUCTION

Facial expression recognition identifies emotion from face image, it is a manifestation of theactivity and personality of a human. In the 20th century, the American psychologists Ekman andFriesen [2] defined six basics' emotions (anger, fear, disgust, sadness, surprise and happiness),which are the same across cultures. Facial expression recognition has brought much attention inthe past years due to its impact in clinical practice, sociable robotics and education. The purposeof this article is to implement emotion recognition in education by realizing an automatic systemthat analyze students' facial expressions based on Convolutional Neural Network (CNN), whichis a deep learning algorithm that are widely used in images classification. It consist of amultistage image processingto extractfeature representations.Our systemincludes three phases:face detection, normalization and emotion recognition that should be one of these sevenemotions:neutral,anger,fear, sadness,happiness,surpriseand disgust.

2. RELATEDWORK

Many researchers are interested in improving the learning environment with Face EmotionRecognition (FER). Tang et al.proposed a system which is able to analyze facial expressions inordertoevaluateclassroom teachingeffect. Thesystem iscomposedoffivephases: dataacquisition,face detection, face recognition, facial expression recognition and post-processing. The approachuses K-nearest neighbor (KNN) for classification and Uniform Local Gabor Binary PatternHistogram Sequence (ULGBPHS) for pattern analysis. Savva et al. proposed a web application thatperforms an analysis of students' emotion who participating in active face-to-face

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classroominstruction. The application uses webcams that are installed in classrooms to collect live recordings,thenthey applied machinelearningalgorithmson its.In Whitehill et al. proposed an approach that recognizes engagement from students' facialexpressions.TheapproachusesGabor features andSVMalgorithmtoidentifyengagementasstudentsinteractedwith cognitive skills training software.

3. PROPOSEDFRAMEWORK

In this section, we describe our proposed system to analyze students' facial expressionsusingaConvolutionalNeural Network (CNN) architecture. First, the system detects the face from inputimage and these detected faces are cropped and normalized to a size of 48×48. Then, these faceimages are used as input to CNN.Finally, the output is thefacial expressionrecognitionresults(anger,happiness,sadness, disgust, surpriseorneutral).

METHODLOGY:

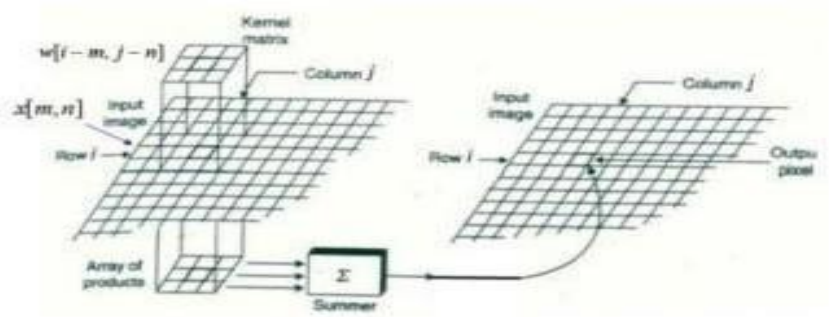
A Convolutional Neural Network(CNN)isadeep artificial neural networks that canidentify visual patterns from i put image with minimal pre-processing compared to otherimage classification algorithms. This means that the network learns the filters that intraditionalalgorithmswerehand-engineered [19]. The important unit inside a CNN layersis a neuron. They are connected together, in order that the output of neurons at a layerbecomestheinputof neuronsatthenextlayerInorder tocomputethepartialderivatives ofthecost functionthe backpropagationalgorithmisused.Theterm convolution refers tothe use of a filter or kernel on the input image to produce a feature map. In fact, CNN modelcontains3 typesoflayersasshowninFigure2:

Fig.CNNarchitecture.

Convolution Layer: is the first layer to extract features from an input image. The primary purposeofConvolutionin case ofaConvNetistoextractfeaturesfromtheinput image.
Convolution preserves the spatial relationship between pixels by learning image features using smallsquares of input data . It performs a dot product between two matrices, whereoneistheimageandtheotherisakernal.Theconvolution formulaisrepresentedin Equation1 :

$$net(t,f) = (x*w)[t,f] = \sum m \sum n x[m, n]w[t - m, f - n] \quad (1)$$

Wherenet(*t,f*)isthe outputinthenextlayer,*x*is theinputimage, *w*isthefiltermatrixand* istheconvolution operation. Figure3,showshowtheconvolutionworks.



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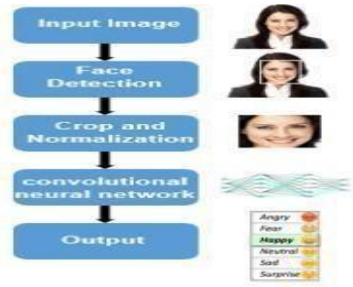
STRUCTUREOFFER:



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CNNIMPLEMENTATION

We used OpenCV library [16] to capture live frames from webcameraandtodetectstudents'facesbasedonHaar Cascades method [14] as shown in Figure 8. Haar Cascades uses the Adaboostlearning algorithm invented by Freund et al. [15], who won the 2003 Gödel Prize for their work. TheAdaboostlearningalgorithmchoseafew number of significant features from a large set inorder to provide effective result of classifiers. We built a Convolutional Neural Network model usingTensorFlow[18]Keras[17]highlevelAPI.

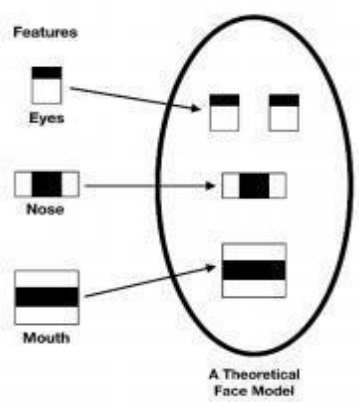

FIG:Face DetectionusingHaar Cascades

4.EXPERIMENTAL RESULTS

We trained our Convolutional Neural Network model using FER 2013 database which includesseven emotions (happiness, anger, sadness, disgust, neutral, fear and surprise) The detected faceimages are resized to 48×48 pixels, and converted to grayscale images then were used for inputs tothe CNN model. Thus, 9 youthful master's students from our faculty participated in the experiment,amoung them there were two wearing glasses. The Figure 11 shows the emotions' results of 9students. The predicted emotion label are represented with red text, and the red bar represents theprobabilityoftheemotion.

We achieved an accuracy rate of 70% at the the 106 epochs. To evaluate the efficiencyandthequalityofourproposedmethodwecalculatedconfusionmatrix,precision,recallandF1-score as shown in Figure 12 and in Figure 13, respectively. Our model is very good forpredicting happy and surprised faces. However it predicts quite poorly feared faces becauseit confuses them with sad faces. In Keras, we used ImageDataGenerator class to performimage augmentation as shown in Figure 9. This class allowed us to transform the trainingimages by rotation, shifts, shear, zoom and flip. The configuration used is :rotation_range=10,width_shift_range=0.1,zoom_range=0.1,height_shift_range=0.1andhorizontal_flip=True.

Original *Transformed*
Fig.ImageaugmentationusingKeras.

5.CONCLUSION AND FUTUREWORK

Inthispaper,wepresentedaConvolutionalNeural Network model for students'facial expression recognition. The proposed model includes 4 convolutional layers, 4 maxpooling and 2 fully connected layers. The system recognizes faces from students' inputimages using Haar-like detector and classifies them into seven facial expressions: surprise,fear, disgust, sad, happy, angry and neutral. The proposed model achieved an accuracy rateof 70% on FER 2013 database. Our facial expression recognition system can helptorecognizecomprehension towards his presentation. Thus,inourfutureworkwewillfocusonapplying Convolutional Neural Network model on 3D students' face image inorder to extract theiremotions.

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