International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

COPY RIGHT

ELSEVIER
SSRN

IJIEMR Transactions, online available on 05th Apr 2023. Link
:http://www.ijiemr.org/downloads.php?vol=Volume-12&issue=Issue 04

10.48047/IJIEMR/V12/ISSUE 04/33

Title **FACIAL EXPRESSION RECOGNITION USING CNN**

Volume 12, ISSUE 04, Pages: 245-252

Paper Authors

K. Manasa, N. Bhavya Madhur, P. Manoghna, P. Sandhya

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

Facial Expression Recognition Using CNN

K. Manasa[1], N. Bhavya Madhuri[2], P. Manoghna[3], P. Sandhya[4]
UG Students, Department of ECE,
Vasireddy Venkatadri Institute of Technology, Nambur, Guntur Dt., Andhra Pradesh.
[1]19bq1a0476@vvit.net, [2] 19bq1a04a6@vvit.net,[3] 19bq1a04b8@vvit.net
[4] 19bq1a04b1@vvit.net

ABSTRACT

This study proposes a novel method for addressing the problem at hand for detecting facial expressions has been developed. Because of the individuality associated with each human's emotions, facial expression recognition is a fascinating research area. Deep Learning is a cutting-edge area of machine learning that excels in solving picture categorization challenges. With excellent accuracy, feature extraction has been accomplished using Deep Learning techniques, mainly Convolutional Neural Networks (CNN). Each face picture in this study is categorized into one of the seven categories of human emotions using a specifically created convolutional neural network. The model was developed using the data set from the Kaggle Facial Expression Recognition Competition namely FER2013, which contains 35,887 grayscale 48 by 48-pixel images.

KEYWORDS: Deep Learning, CNN, Facial Expression Recognition

1. INTRODUCTION

Without speaking a word, it may convey a wide range of feelings. Facial expression recognition extracts emotion from a facial picture and uses it to determine an individual's mood and personality. The six universally recognized fundamental emotions—anger, fear, disgust, sad, surprise, and happiness—were identified by American psychologists Ekman and Friesen in the 20th century. Due to its effects on clinical treatment, social robots, and education, facial expression recognition has received a lot of attention lately. Several studies have shown that emotions are significant in teaching. Exams, questionnaires, and observations are currently used by teachers as sources of feedback; however, these traditional approaches are frequently ineffective. The instructor can modify their method and their educational materials based on the facial expressions.

The goal is to teach computers to perceive and interpret visual information in a way that is similar to how humans do, and to produce the desired output based on that input. However, achieving this level of sophistication can be a complex and challenging undertaking. One specific challenge is the need to account for individual differences in how people express visual information, which can make it difficult to develop computer algorithms that work consistently and accurately.

2.LITERATURE SURVEY

Deep Learning is a dominant subset of Machine Learning, particularly in the context of processing image data. Unlike traditional Machine Learning models, Deep Learning models are better equipped to handle large image datasets with higher efficiency. In addition, Deep Learning algorithms are capable of assessing the accuracy of their own predictions, making them more autonomous and reliable in producing accurate results. Hong Wei NG and colleagues utilized a transfer learning method that leveraged pre-trained Deep CNN architectures on the ImageNet dataset. They then fine-tuned the network in two stages by utilizing two distinct datasets. Through their experiments, they found that this multi-stage fine-tuning approach resulted in superior performance [1]. Similarly,[2] another study proposed a face detection classification network composed of multiple deep CNNs.

Several studies have proposed different methods for facial expression recognition. Heechul Jung and colleagues utilized a two-stage approach that first detected the face using Haar-like features .They correlated two types of deep networks then found that the convolutional neural network outperformed the other neural network [3]. Similarly,[4] Ma Xiaoxi and colleagues employed a Deep Boltzmann Machine and SVM, while Ali Mollahosseini and colleagues designed a network consisting of convolutional and Inception layers [5]. A novel offered Abir Fathallah CNN-based architecture for facial expression recognition, which was fine-tuned using the Visual Geometry Group model and achieved better results [6]. Neha Jain and colleagues implemented a network hybrid Convolution-Recurrent Neural Network method that extracted image patterns using Convolution layers [7] and considered temporal dependencies during classification using Recurrent Neural Network layers. Finally, [8] Bazrafkan highlighted the importance of using consistent databases for training and testing, as using different databases can result in lower accuracy in predicting emotions.

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

3.PROPOSED METHODOLOGY

Our proposed the system first recognizes the face in the input image, and then it crops and normalizes the identified faces to a size of 48x48. These facial photos are then sent into CNN. The output, which includes findings for facial expression recognition.

Convolutional Neural Networks are a subset of deep learning, and their ability to independently assess if an estimate is true or not is one of the reasons that deep learning is preferred over machine learning. Moreover, Deep Learning networks outperform traditional ML algorithms when dealing with vast amounts of data, and picture categorization is an area where Deep Learning has outperformed Machine Learning in terms of quality. Convolutional Neural Networks, or ConvNets, are similar to standard Neural Networks in many ways.

3.1 CONVOLUTION LAYERS

The Convolutional Neural Network (CNN) consists of three main types of layers: the The First Layer extracts features from the input image using a filter of a particular size, generating a feature map that preserves the spatial relationship between pixels. Feature map size can be reduced using Max, Average or Sum pooling, and acts as a bridge between the Convolution Layer and the Fully Connected Layer. The third layer contains the weights, biases, and neurons that connect neurons between two different layers and performs mathematical operations on the flattened vector from the previous layer, facilitating the classification process. Two fully connected layers are often used to improve performance and automate feature extraction. Overall, these layers work together to extract meaningful input image features and classify it accurately.

3.2 BLOCK DIAGRAM:

The objective of this project is to use a Convolutional Neural Network to accurately detect the emotions displayed on human faces. The network architecture consists of three convolutional layers go along with a pooling layer, fully connected layer at the end.

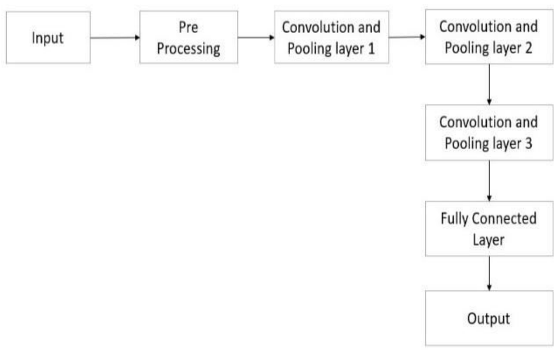

Fig 1. Flow chart

In the fully connected layer to produce the final output an activation function namely Softmax is used. The combination of these

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

layers enables extract meaningful features from the input image, allowing it to accurately classify the emotion displayed on the face.

3.3 DATASET:

This model has been trained using the FER2013 dataset. This dataset comprises 35,887 grayscale images of human faces, each with dimensions of 48 by 48 pixels. To evaluate the model's performance, we split the dataset into three parts in the ratio of 80:10:10 for training, cross-validation and testing.

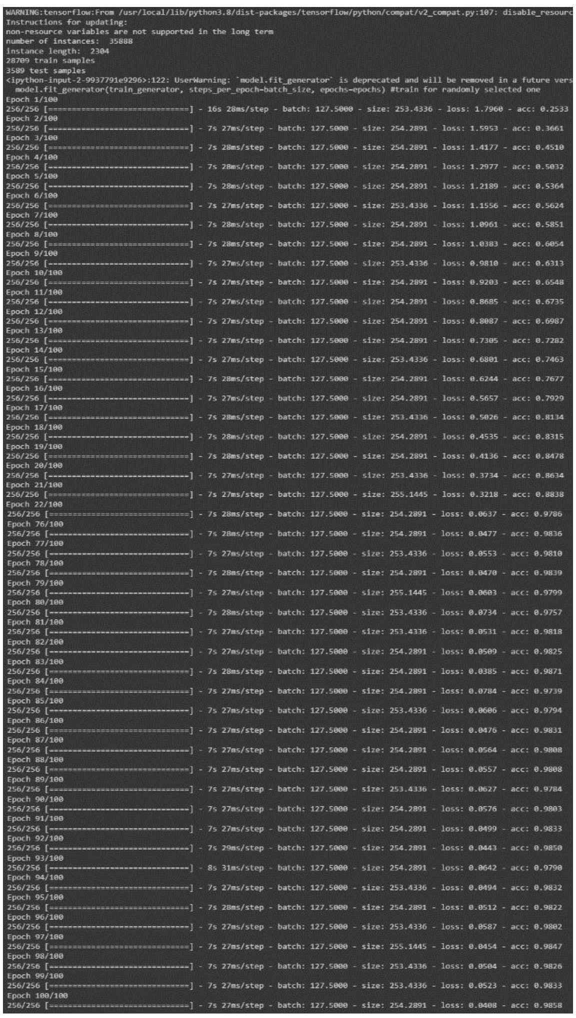

Fig: Trained model

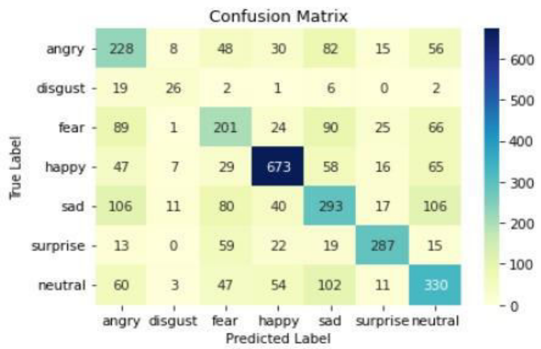

Fig : Confusion matrix

According to the dataset, detecting the emotion of happiness was the easiest task with an accuracy of 0.88, followed by

surprise with an accuracy of 0.81. However, predicting the emotion of fear proved to be difficult with least accuracy of 0.47. On average, the accuracy for all seven different emotions was approximately 0.64.

3.4 RESULTS OF TRAINED MODEL:

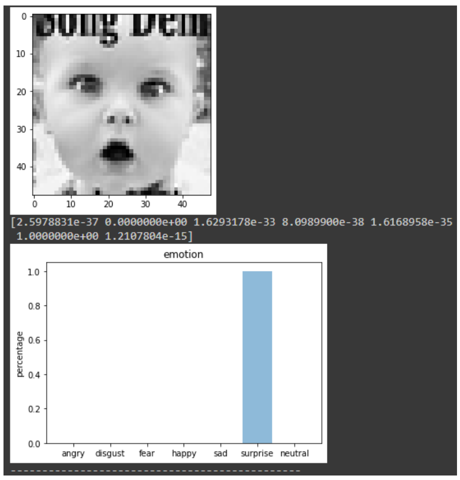

Fig: Trained model surprise image

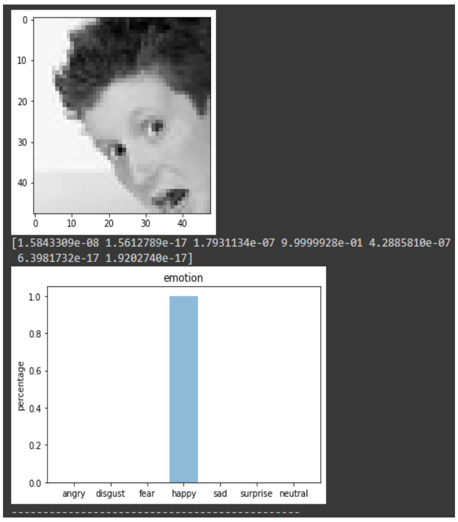

Fig: Trained model happy image

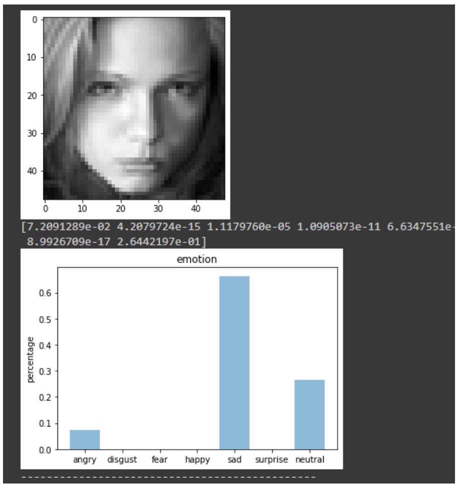

Fig: Trained model false prediction

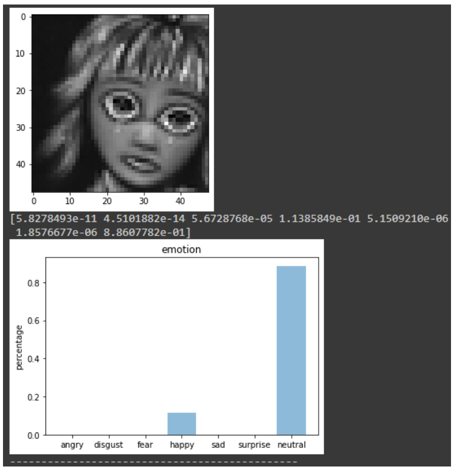

Fig: Trained model false prediction

4.RESULT ANALYSIS:

To improve the networks rate of learning, a Batch Normalization Layer has been added after the convolutional layers. Nonlinearity is introduced in the network through the Activation Layer, and the Pooling Layer. The model has been trained using 80% of the data from the FER2013 dataset for a total of 60 epochs, as indicated by the graph. The proposed architecture's configuration is presented in Table 1, which provides different stages of output layers.

Fig : Emotion detection on an image

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

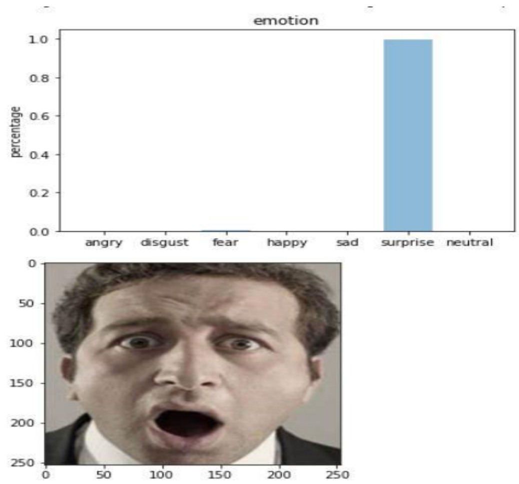

Fig : Detection of an emotion

5.CONCLUSION:

Facial Emotion Recognition has been extensively studied due to its numerous practical applications.

A neural network architecture is proposed for recognizing facial emotions in images, which includes 3 convolutional layers, 3 pooling layers, and a fully connected layer with an activation function namely Softmax.

The FER2013 is used to trained the proposed model and can be evaluated on both dataset images and saved or captured images from a webcam.

The model performs best in recognizing Happy and Surprise emotions, while it struggles to accurately predict Fear and Anger emotions.

6.REFERENCES:

[1] Ng, H. W., Nguyen, V. D., Vonikakis, V., & Winkler, S. (2015, November). Deep learning for emotion recognition on small datasets using transfer learning. In Proceedings of the 2015 ACM on international conference on multimodal interaction (pp. 443-449).

[2] Yu, Z., & Zhang, C. (2015, November). Image based static facial expression recognition with multiple deep network learning. In Proceedings of the 2015 ACM on international conference on multimodal interaction (pp. 435-442).

[3] Jung, H., Lee, S., Park, S., Kim, B., Kim, J., Lee, I., & Ahn, C. (2015, January). Development of deep learning-based facial expression recognition system. In 2015 21st Korea-Japan Joint Workshop on Frontiers of Computer Vision (FCV) (pp. 1-4). IEEE.

[4] Xiaoxi, M., Weisi, L., Dongyan, H., Minghui, D., & Li, H. (2017, August). Facial emotion recognition. In 2017 IEEE 2nd International Conference on Signal and Image Processing (ICSIP) (pp. 77-81). IEEE.

[5] Mollahosseini, A., Chan, D., & Mahoor, M. H. (2016, March). Going deeper in facial expression recognition using deep neural networks. In 2016 IEEE Winter conference

on applications of computer vision (WACV) (pp.1-10).IEEE.

[6] Lv, Y., Feng, Z., & Xu, C. (2014, November). Facial expression recognition via deep learning. In 2014 international conference on smart computing (pp. 303-308). IEEE.

[7] Jain, N., Kumar, S., Kumar, A., Shamsolmoali, P., & Zareapoor, M. (2018). Hybrid deep neural networks for face emotion recognition. Pattern Recognition Letters,115,101-106.

[8] Bazrafkan, S., Nedelcu, T., Filipczuk, P., & Corcoran, P. (2017, January). Deep learning for facial expression recognition: A step closer to a smartphone that knows your moods. In 2017 IEEE International Conference on Consumer Electronics (ICCE) (pp. 217-220). IEEE.

[9] Matsumoto, D., & Willingham, B. (2009). The origin of universal human emotions. San Francisco: San Francisco State University.

[10] Mollahosseini, A., Chan, D., & Mahoor, M. H. (2016, March). Going deeper in facial expression recognition using deep neural networks. In 2016 IEEE Winter conference on applications of computer vision (WACV) (pp.1-10).IEEE.

[11] Viola, P., & Jones, M. J. (2004). Robust real-time face detection. International journal of computer vision, 57, 137-154.

[12] Lajevardi, S. M., & Lech, M. (2008, November). Facial expression recognition from image sequences using optimized feature selection. In 2008 23rd international conference image and vision computing New Zealand (pp. 1-6). IEEE.

[13] Cheng, C. F., Rashidi, A., Davenport, M. A., & Anderson, D. V. (2017). Activity analysis of construction equipment using audio signals and support vector machines. Automation in Construction, 81, 240-253.

[14] Samad, R., & Sawada, H. (2011). Extraction of the minimum number of Gabor wavelet parameters for the recognition of natural facial expressions. Artificial Life and Robotics, 16, 21-31.

[15] Saudagare, P. V., & Chaudhari, D. S. (2012). Facial expression recognition using neural network–An overview. International Journal of Soft Computing and Engineering, 2(1), 224-227.

[16] Ranzato, M. A., Susskind, J., Mnih, V., & Hinton, G. (2011, June). On deep generative models with applications to recognition. In CVPR 2011 (pp. 2857-2864). IEEE.

[17] Rifai, S., Bengio, Y., Courville, A., Vincent, P., & Mirza, M. (2012). Disentangling factors of variation for facial

expression recognition. In Computer Vision–ECCV 2012: 12th European Conference on Computer Vision, Florence, Italy, October 7-13, 2012, Proceedings, Part VI 12 (pp. 808-822). Springer Berlin Heidelberg.

[18] Lajevardi, S. M., & Hussain, Z. M. (2009, March). Feature selection for facial expression recognition based on mutual information. In 2009 5th IEEE GCC Conference & Exhibition (pp. 1-5). IEEE.

[19] Ma, L., & Khorasani, K. (2004). Facial expression recognition using constructive feedforward neural networks. IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics), 34(3), 1588-1595.

[20] Shan, C., Gong, S., & McOwan, P. W. (2009). Facial expression recognition based on local binary patterns: A comprehensive study. Image and vision Computing, 27(6), 803-8