A Review of Facial Expression System Using Machine Learning Techniques

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Abstract: *Face expression Recognition (FER) is one of the most powerful and challenging tasks in social communication and the best way for non verbal communication. Normally, face expressions are direct means for human beings to communicatetheir emotions and intentions. In this paper different FER techniques and models are reviewed in brief. Many researchers used machine learning algorithms like decision tree, neural network for the FER system. For the Performance improvement of FER system Convolution Neural network (CNN) and recurrent neural network (RNN) is also used. The performance of various FER techniques is compared based on the number of expressions recognized and complexity of algorithms. Databases likeJAFFE, CK+, and some other variety of facial expression dataset are also discussed in this paper.*

Keywords: *Facial Expression Recognition (FER), Machine learning Techniques, Convolution Neural network (CNN),Recurrent neural network (RNN), Pre-processing, Feature Selection*

1. INTRODUCTION:

Human-Computer Interaction (HCI) has become increasingly important in our daily lives as we live in a digital world. Recently with the development of Artificial Intelligence (AI) and its subfields like Machine Learning and Deep Learning, uses computer vision systems to detect human emotions from facial expressions increasingly. The process of emotion detection from face is known as Facial Expression Recognition (FER).Facial expression recognition is based on advanced computer vision algorithms that analyze a person's face and extract key features from it. These features are then used to identify the facial expressions or emotions being expressed. The technology is used in a variety of applications, including security, entertainment, health care, marketing, video games, online meetings, E-learning, driver fatigue, robotics, and behavioural science.Facial Expression Recognition is a way for machines to understand emotions and the context of certain situations. The six universal facial expressions (Anger, Disgust, Fear, Happy, Sad and Surprise) have been identified by Ekman et al. And are often seen in facial expression datasets[10]. Recently, a seventh facial expression (Neutral) has been added to the list.

Figure 1.1: Different Facial Expression of One Japanese Female (JAPFEE) Dataset

Now days communication between machines through internet has increasingly with the help of Internet of things (IoT) individual Computer Interaction(HCI) and robotization, Emotion detection has turned intoan essential pasture of learn. Non-verbal communication is done through human facial expressions and frame gestures. More than fifty-five percent of expressions are mainly made from human body moves[1].Facial expressions are important becausethey express information that can be widely usedin various applications in different ways. Furthermore, facialexpressions can get across the same information to differentcultures and countries.It remains challenging for computer systems and robots to classifyFacial expressions under extraordinary light conditions, poses, and Backgrounds and across people of various a regions, genders, and ethnicities.

Researchers have studied various processes for facial detection using Decision trees, deep learning andconvolution neural networks (CNN). CNN has been verified to be a critical method of extracting neighbourhood spatial capabilities of images. Long short-termmemory (LSTM) and recurrent neural network (RNN) is also used to establish the relationship between the transformationof facial expressions in image sequences and the six basic emotions. FACS (Facial Action Coding System) with the combination of CNN & LSTM is applied for quantifying human facial movement.An action unit (AU) is comprised of segments of themuscles involved in facial expression. An AU is one of46 minor elements of visible facial motion or its relatedformchanges.

The conventional methods of facial emotion recognitionusually collaborate with feature extraction, feature classification, and data dimension reduction algorithms and putforward stringent requirements for the

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running state ofalgorithms at each stage [7].Hybrid CNN-RNN model and Deep Neural Networks (DNNs) model show the most promise for face-processing applications.Facial expressions needed a spatial relationship between different facial regions. However, CNN Models are not fully successes to capture such a relationship because they are performed on image regions only. Bidirectional LSTM-CNN [6] is also useful for network model to learn from complete time series at each time step. Therefore, it's needed to improve ourface expression recognition system performance by exploring long-term dependencies, especially for the spatial dependencieswithin facial expression images.Neural network models areconstantly improving and developing with the improvementin computers. Improvement of Performance in facial recognition system is the current need of modern artificial intelligence era. Many model gives better accuracy in detection of emotions from images by uses Facial dataset.

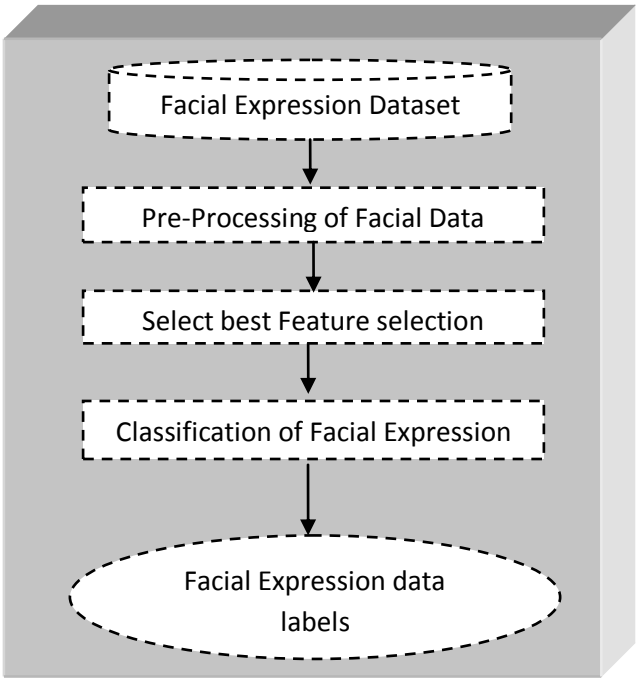

Figure 1.2: Basic Facial Expression Recognition System

2. FACIAL EXPRESSION DATASET:

CK+ Database: The extended Cohn-Kanade, or the CK+ database, is a public facial expression dataset for action units and emotionrecognition [13]. This dataset includes both posed and spontaneous expressions. We use The Extended Kohn-Canade(CK+) database, which consists of 981 images obtained from video sequences from a total of 123 different subjects,ranging from 18 to 50 years of age, with various genders and heritage posing seven classes of emotion. The datasetcan be accessed at the following link https://www.kaggle.com/datasets/shawon10/ckplus.

FER 2013 Data Set: Fer2013 data set is mainlyfrom the well-known data science competition platform Kaggle. Data is obtained by searching for image keywordsthrough the Google search engine, including 35,887gray-scale images with a resolution of $48 * 48$ pixels. Table 1shows the details of various expressions in the Fer2013 data set [3]. Dataset is rich and diverse since the images arecrawled from the network, but the data contains a lot ofnoise, which is a challenge for facial expression recognitionclassification algorithms.

JAFFE(Japanese Female Facial Expression) Dataset: JAFFE database is widely used whichcontains 10 Japanese feminine's expressions through 7different Facial Expressions in addition to contain Total 213Gray Imagery with resolution of 256*256 for each image [1]. Itcontains 7 basic facial expressions which include Angry,Disgust, Fear, Happy, Neutral, Sad and Surprise.

3.LITERATURE SURVEY:

There are several works related to emotion recognition, facialexpression recognition, deep neural network and convolution neural network, recurrent neural network. Detailed review of the work is discussed in this chapter.

Authors [1] propose aFramework that combines discriminative features discoveredusing Convolution Neural Networks (CNN) to enhance theperformance and accuracy of Facial Expression Recognition.Authors proposed feature concatenationarchitecture with Deep Learning approach. In thisexperiment and results our proposed architecture showsimproved performance compare to pre-trained CNNarchitecture which does not do any feature concatenation.

Authors [2] propose a Hybrid Convolution-Recurrent Neural Network method for FER in Images. Theproposed network architecture consists of Convolution layers followed by Recurrent Neural Network (RNN) which thecombined model extracts the relations within facial images and by using the recurrent network the temporal dependencies whichexist in the images can be considered during the classification. The proposed hybrid model is evaluated based on two publicdatasets and Promising experimental results have been obtained as compared to the state-of-the-art methods.

Authors [3] propose the BiLSTM-CNNmodel, which combines our proposed CNN and BiLSTM model. Besides that, we also compare the model to our CNN and LSTMCNNmodels. We conduct the experiments on the CK+ dataset and evaluate the accuracy rate of the built models. Dataaugmentation is used in the dataset to improve the model's performance and prevent overfitting. The results demonstrate that theBiLSTM-CNN method achieves a state-of-the-art accuracy rate compared to other methods from previous work. The highestaccuracy of 99.43% is reached by the BiLSTM-CNN model with data augmentation.

Authors [5] proposed a model that combines CNN andLSTM and exploits the advantages of both CNN and RNN.Leave-one-out cross-validation indicates that the model performance is improved significantly. In this workproposes an emotion recognition system for a humanoid robot.

4. FINDING OF THE REVIEW

It is find that many researchers uses neural network system for recognize the facial expression. Combination of Convolution neural network (CNN) and Recurrent neural network (RNN) based model are gives better performance for classifying emotions from facial dataset. For improving the performance long short-termmemory (LSTM) and

recurrent neural network (RNN) is also used to establish the relationship between the transformationof facial expressions in image sequences and the six basic emotions. It is also find that Facial expression recognition (FER) system process are the used basic three steps that is pre-processing of image, selected best features and classy the images expression. Hybrid model is also used by some authors for improving the FER model Performance.

5. CONCLUSION

FER is used in real-timeapplications such as driver sate surveillance, medical, roboticsinteraction, forensic section, detecting deceptions. This review is useful for developing a high performance FER model. This survey compares algorithms based on pre-processing,feature extraction, classification and major contributions. It is found that convolution and recurrent neural network based FER model mainly used for improving the FER system.

REFERENCES:

[1]. Chintan B. Thacker, Ramji M. Makwana "Ensemble of Multi Feature Layers in CNN for Facial Expression Recognition using Deep Learning" International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878 (Online), Volume-8 Issue-4, November 2019

[2]. Jin-Chul Kim 1, Min-Hyun Kim 1, Han-Enul Suh 1 , Muhammad Tahir Naseem 2 and Chan-Su Lee 1,3 "Hybrid Approach for Facial Expression Recognition Using Convolutional Neural Networks and SVM" Appl. Sci. 2022, 12, 5493. https://doi.org/10.3390/app12115493https://www.mdpi.com/journal/applsci

[3]. Ye Ming ,1,2 Hu Qian,1 and Liu Guangyuan2 "CNN-LSTM Facial Expression Recognition Method Fused with Two-Layer Attention Mechanism" Hindawi Computational Intelligence and Neuroscience Volume 2022, Article ID 7450637, https://doi.org/10.1155/2022/7450637

[4]. Upendra Kumar Kachhwaha, Anurag Shrivastava. Credit Threat Estimation by Machine Learning Techniques Over Cloud Platform. International Research Journal of Engineering & Applied Sciences (IRJEAS). 8(4), pp. 11-16, 2020. https://www.irjeas.org/wp-content/uploads/admin/volume8/V8I4/IRJEAS04V8I410201220000004.pdf.

[5]. Tzuu-hseng s. li 1, (member, ieee), ping-huan kuo 2, ting-nan tsai1, and po-chien luan1 "CNN and LSTM Based Facial ExpressionAnalysis Model for a Humanoid Robot " Received June 19, 2019, accepted July 4, 2019, date of publication July 11, 2019, date of current version July 30, 2019. Digital Object Identifier 10.1109/ACCESS.2019.2928364

[6]. Sana Khan, Shailendra Singh Pawar. Radar Pulse Compression Using LM Neural Network. International Research Journal of Engineering & Applied Sciences, IRJEAS, 2(3), pp. 47-51, 2014. https://www.irjeas.org/wp-content/uploads/admin/volume2/V2I3/V2I3_07140914_0014.pdf.

[7]. B. Michael, Diego Serrano. PSO WITH NEURAL NETWORK APPROACH FOR NETWORK SELECTION AND FAST DELIVERY HANDOVER ROUTE IN 5G. International Research Journal of Engineering & Applied Sciences, (IRJEAS). 9(3), pp. 01-04, 2021. https://doi.org/10.55083/irjeas.2021.v09i03001.

[8]. Neha Jain a, Shishir Kumara,Amit Kumara, Pourya Shamsolmoalib,c, Masoumeh Zareapoorb "Hybrid Deep Neural Networks for Face Emotion Recognition" 10.1016/j.patrec.2018.04.010 www.elsevier .com

[9]. Jiwani, N., & Gupta, K. (2018). Exploring Business intelligence capabilities for supply chain: a systematic review. Transactions on Latest Trends in IoT, 1(1), 1-10. Retrieved from https://www.ijsdcs.com/index.php/TLIoT/article/view/136

[10]. Rio Febriana*, Benedic Matthew Halima, Maria Christinaa, Dimas Ramdhana, AndryChowanda "Facial expression recognition using bidirectional LSTM - CNN" 7th International Conference on Computer Science and Computational Intelligence 2022 www.sciencedirect.com

[11]. Dimin Zhu,1 Yuxi Fu,2 Xinjie Zhao,3 Xin Wang ,4 and Hanxi Yi5 "Facial Emotion Recognition Using a Novel Fusion of Convolutional Neural Network and Local Binary Pattern in Crime Investigation" ume 2022, Article ID 2249417, 14 pages https://doi.org/10.1155/2022/2249417

[12]. Anurag Shrivastava, Jyoti Sondhi, Bharat Kumar. MACHINE LEARNING TECHNIQUE FOR PRODUCT CLASSIFICATION IN E-COMMERCE DATA USING MICROSOFT AZURE CLOUD. International Research Journal of Engineering & Applied Sciences, IRJEAS, 5(2), pp. 11-13, 2017. https://www.irjeas.org/wp-content/uploads/admin/volume5/V5I2/IRJEAS04V5I204170617000003.pdf.

[13]. Anurag Shrivastava, Jyoti Sondhi, Sunita Ahirwar. CYBER ATTACK DETECTION AND CLASSIFICATION BASED ON MACHINE LEARNING TECHNIQUE USING NSL KDD DATASET. International Research Journal of Engineering & Applied Sciences, IRJEAS, 5(2), pp. 28-31, 2017. https://www.irjeas.org/wp-content/uploads/admin/volume5/V5I2/IRJEAS04V5I204170617000005.pdf.

[14]. Dimitrios Kollias and Stefanos Zafeiriou "Exploiting multi-CNN features in CNN-RNN based Dimensional Emotion Recognition on the OMG in-the-wild Dataset" DOI 10.1109/TAFFC.2020.3014171, IEEE Transactions on Affective Computing

[15]. Arnold Sachit A Hans, Smitha Rao "A CNN-LSTM" based deep neural network for facial emotion detection in video" Int. J. Adv. Sig. Img.Sci Vol. 7 No. 1, 2021

[16]. Rahul Chourasiya, Vaibhav Patel, Anurag Shrivastava. CLASSIFICATION OF CYBER ATTACK USING MACHINE LEARNING TECHNIQUE AT MICROSOFT AZURE CLOUD. International Research Journal of Engineering & Applied Sciences, IRJEAS, 6(1), pp. 04-08, 2018. https://www.irjeas.org/wp-content/uploads/admin/volume6/V6I1/IRJEAS04V6I101180318000001.pdf.

[17]. SouravRanjan, Vaibhav Patel, Anurag Srivastava. CHRONIC KIDNEY DISEASE RISK PREDICTION

BASED ON MACHINE LEARNING TECHNIQUE USING CLOUD PLATFORM. International Research Journal of Engineering & Applied Sciences, IRJEAS, pp. 33-35, 2018. https://www.irjeas.org/wp-content/uploads/admin/volume6/V6I3/IRJEAS04V6I307180918000006.pdf.

[18]. P. Ekman,W. V. Friesen, M. O'Sullivan, A. Chan, I. Diacoyanni-Tarlatzis, K. K. Heider, W. A. LeCompte, T. Pitcairn, P. E. Ricci-Bitti, K. Scherer, M. Tomita, and A. Tzavaras, ``Universals and cultural differences in the judgments of facial expressions of emotion," J. Personality Social Psy- chol., vol. 53, no. 4, pp. 712_717, 1987.

[19]. K. Gupta, N. Jiwani, N. Afreen and D. D, "Liver Disease Prediction using Machine learning Classification Techniques," *2022 IEEE 11th International Conference on Communication Systems and Network Technologies (CSNT)*, 2022, pp. 221-226, doi: 10.1109/CSNT54456.2022.9787574.

[20]. N. Jiwani, K. Gupta, M. H. U. Sharif, N. Adhikari and N. Afreen, "A LSTM-CNN Model for Epileptic Seizures Detection using EEG Signal," *2022 2nd International Conference on Emerging Smart Technologies and Applications (eSmarTA)*, 2022, pp. 1-5, doi: 10.1109/eSmarTA56775.2022.9935403.

[21]. H Cao, D G Cooper, M K Keutmann, R C Gur, A Nenkova, R Verma "CREMA-D: Crowd-sourced Emotional multimedia actors dataset" IEEE Trans Affect Computer, Vol 5, No. 4, 2014,pp, 377-390

[22]. Kollias, D., Zafeiriou, S.: Aff-wild2: Extending the aff-wilddatabase for affect recognition. arXiv preprint arXiv:1811.07770 (2018)

[23]. Mohammad Faraz Rayeen, Arun Singh Patel. Design and study of Automotive Chassis bracket using structural Finite Element Analysis. International Research Journal of Engineering & Applied Sciences, IRJEAS, 7(4), pp. 01-06, 2019. https://www.irjeas.org/wp-content/uploads/admin/volume7/V7I4/IRJEAS04V7I410191219000002.pdf.

[24]. Lucey P, Cohn JF, Kanade T, Saragih J, Ambadar Z, Matthews I. The extended Cohn-Kanade dataset (CK+): A complete dataset for action unit and emotion-specified expression. 2010 IEEE Computer Society Conference on Computer Vision and Pattern Recognition - Workshops, CVPRW 2010 2010:94–101. https://doi.org/10.1109/CVPRW.2010.5543262.

[25]. Theresa Küntzler 1*†, T. Tim A. Höfling2† and Georg W. Alpers 2 "Automatic Facial Expression Recognition in Standardized and Non-standardized Emotional Expressions" published: 05 May 2021 doi: 10.3389/fpsyg.2021.627561www.frontiersin.org

[26]. K. Gupta, N. Jiwani and N. Afreen, "Blood Pressure Detection Using CNN-LSTM Model," *2022 IEEE 11th International Conference on Communication Systems and Network Technologies (CSNT)*, 2022, pp. 262-366, doi: 10.1109/CSNT54456.2022.9787648.

[27]. N. Jiwani, K. Gupta and N. Afreen, "Automated Seizure Detection using Theta Band," *2022 International Conference on Emerging Smart Computing and Informatics (ESCI)*, 2022, pp. 1-4, doi: 10.1109/ESCI53509.2022.9758331.

[28]. Upendra Sah, Santosh Kumar. A REVIEW ON EFFICIENT FAULT DIAGNOSIS SCHEME FOR PV SYSTEM USING MACHINE LEARNING TECHNIQUES IN THE DC SIDE. International Research Journal of Engineering & Applied Sciences, IRJEAS, 8(3), pp. 17-21, 2020. https://www.irjeas.org/wp-content/uploads/admin/volume8/V8I3/IRJEAS04V8I307200920000003.pdf.

[29]. Michael Revina, W.R. Sam Emmanuel "A Survey on Human Face Expression Recognition Techniques" www.sciencedirect.com