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Detection of Facial Expression

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ABSTRACT

Human emotions are reflected in facial expressions. The focus of attention, intention, motivation, and emotion are just a few of the social cues it provides to the viewer. It is thought to be an effective method for communicating in silence. These expressions can be analyzed to provide a much deeper understanding of human behavior. In recent years, AI-based facial expression recognition (FER) has emerged as one of the most important areas of research with various applications in dynamic analysis, pattern recognition, interpersonal interaction, mental health monitoring, and a variety of other fields. However, a new FER analysis framework for the growing amount of visual data generated by videos and photographs has been urgently required due to the global push toward online platforms by the Covid-19 pandemic. Additionally, the FER study must take into account the various emotions-related facial expressions of children, adults, and seniors. There has been a lot of research done in this area. However, it lacks a comprehensive literature review that identifies aligned future directions and highlights previous accomplishments. In this paper, the authors provide an in-depth analysis of AI-based FER techniques, focusing on datasets, feature extraction techniques, algorithms, and the most recent developments in facial expression identification applications. This is, to the best of the author's knowledge, the only review paper that covers all aspects of FER across age groups and will have a significant impact on the research community in the years to come.

Keywords: *Facial Expression Recognition (FER),* CNN model.

INTRODUCTION

The visual expressions of human face that people see all around them. They are innate signals that assist them in comprehending the feelings of any individual in front of them or in images or videos. These feelings are profoundly complicated and testing to comprehend for machines however effectively justifiable by people. Famous psychologist Mehrabian discovered in his research that the emotional data that humans classify as emotions are divided into sections, which helps explain how humans could comprehend such emotions. He discovered that only 7% of the total emotional data is transmitted through language, while 38% is transmitted through our language auxiliary, which varies from culture to culture and includes things like speech rhythm, tone, pitch, and so on. So far, 55% of facial expressions have revealed emotional information [1].

Because of this, it is absolutely necessary to conduct a more in-depth investigation of this research field because commercial applications are plagued by inaccurate systems.

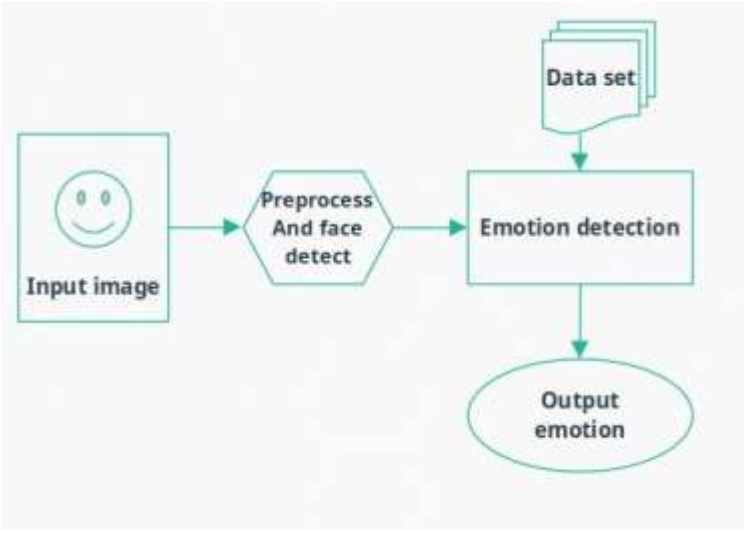
LITERATURE SURVEY

Sl. No.	Publication Details	Worked Carried out Papers	Drawbacks
1	I. M. Revina and W.R.S. Emmanuel, ''A survey on human face expression recognition techniques,'' J. King Saud Univiversity - Comput. Inf. Sci., vol. 33, no. 6, pp. 619–628, Sep. 2018,	Different techniques and their performance on data sets were discussed.	Lack of proper discussion of CNN in FER
2	K. Chengeta and S. Viriri, ''A survey on facial recognition based on local directional and local binary patterns,'' in Proc. Conf. Inf. Commun. Technol. Soc. (ICTAS), Mar. 2018,	Review and present and assemble classifier based on traditonal feature extraction methods.	There isn't enough emphasis on new DL approaches for FER.
3	G. Rajeswari and P. IthayaRani, ''Literature survey on facial expression recognition techniques,'' in Proc. 3rd Int. Conf. Commun. Electron. Syst. (ICCES), Oct. 2018,	To investigate and survey a variety of FER approach.	There is not enough discussion of FER methodologies, future problems, present concerns and datasets
4	A. S. Vyas, H. B. Prajapati, and V. K. Dabhi, ''Survey on face expression recognition using CNN,'' in Proc. 5th Int. Conf. Adv. Comput. Commun. Syst. (ICACCS), Mar. 2019,	A detailed examination of the various CNN architectures used for FER on various data sets	CNN's problems and challenges are not highlighted.
5	B. Martinez, M. F. Valstar, B. Jiang, and M. Pantic, ''Automatic analysis of facial actions: A survey,'' IEEE Trans. Affect. Comput., vol. 10, no. 3, pp. 325–347, Jul. 2019	To investigate alternate detection extraction and machine learning classification methods for FER through a detailed survey.	DL techniques were not discussed
6	I. Adjabi, A. Ouahabi, A. Benzaoui, and A. Taleb-Ahmed, ''Past, present, and future of face recognition: A review,'' Electronics, vol. 9, no. 8, Jul. 2020,	A detailed review of 2D and 3D face recognition methods using 4 different approaches.	The deep learning algorithm presented are bit outdated.
7	E. Dufourq, ''A survey on factors affecting facial expression recognit- ion based on convolutional neural networks,'' in Proc. Conf. South African Inst. Comput. Sci. Inf. Technol., Sep. 2020,	Surveyed various CNN models on FER	Did not provide a proper classifications of data sets and work done on them.
8	K. Bayoudh, R. Knani, F. Hamdaoui, and A. Mtibaa, ''A survey on deep multimodal learning for computer vision: Advances, trends, appli- cations, and datasets, 2021	Various multi-model approaches were discussed along with their applications in details	The authors didn't specified any algorithms for the proposed methods

Methodology

Keras is used in the design and training of the CNN model. We use OpenCV's face detection classifier to draw bounding boxes around the faces that are automatically detected. The network is saved and trained following the creation of the facial model. The trained model is then put into action via a Flask-built web interface. After the Emotion Recognition model has been trained, the main Python script is run, which loads the trained model and saved weights and then applies the model to a locally saved video file or a webcam-based real-time video stream. Keras is used to automatically generate mini-batches for training and validation (test) by feeding data from the training and test folders. The data loader has some defined hyper-parameter settings. The batch size is 64, and the image is taken at 48 by 48. The batch size is a gradient descent hyperparameter that controls the number of training samples that must be processed before the model's internal parameters are updated. The function of ImageDataGenerator Keras is used to generate data generators for the training and validation sets by randomly flipping images on their horizontal axis.

In this project, a sequential CNN model is used. Four convolution blocks go through the input first. The general workflow of various convolution architectures involves gradually increasing the number of filters. The data are processed through Convolution, Batch Normalization, RELU (non-linearity), Max Pooling, and Dropout regularization in each block. After the fourth convolution block, the output is flattened and sent to the two fully connected layers. Finally, the output label for one of the seven emotions is predicted using the dense layer with Softmax Activation. With a learning rate of 0.0005, the Adam optimizer is utilized, which reduces training time to approximately 9 minutes per epoch. The model.summary() function is used to output all of the parameters that the Model will need to learn, which are approximately 3 million in this instance.



Hyperparameter of gradient descent that controls how many training samples must be processed before the model's internal parameters are changed. The ImageDataGenerator function of Keras is used to generate data generators for the training and validation sets by randomly flipping images on their horizontal axis.

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various convolution architectures involves gradually increasing the number of filters. The data are processed through Convolution, Batch Normalization, RELU (non-linearity), Max Pooling, and Dropout regularization in each block. The volume decreases by a factor of two at each convolution bock, but the number of channels nearly doubles.

After the fourth convolution block, the output is flattened and sent to the two fully connected layers. With a learning rate of 0.0005, the Adam optimizer is utilized, which reduces training time to approximately 9 minutes per epoch. The model.summary() function is used to output all of the parameters that the Model will need to learn, which are approximately 3 million in this instance.

Expected Outcome

Our proposed worked aimed to implement real-time facial emotion recognition with the help of machine learning technology which can able to detect human emotion.

• Identify easily human emotions: anger, disgust,fear, happiness, sadness, surprise and neutrality. User information's aresecured and safe.

• We have combined the science of psychology,human expressions and Artificial intelligence to recognize different universal emotions on an individual's face automatically.

• Easily deploy human emotion in robots.

Conclusion

The paper attempted to present all significant aspects of FER because FER has received a lot of attention from researchers and there is currently less research that provides a complete picture of this field. A brief synopsis of the methods and cutting-edge models utilized in FER for various dataset categories was provided by the authors. This paper looked at all of the FER surveys that have been done before, learned what's missing, and addressed all of the problems.

There are three types of FER datasets: Children, adults, and senior citizens to comprehend the extensive FER outreach. According to the comparison analysis of the datasets, the current focus area is the creation of a new Kids database due to a lack of well-balanced datasets. Using a variety of approaches and cutting-edge CNN models, this paper also discusses the various stages of FER, including feature extraction, classification, and pre-processing. It also compares various CNN models and their benchmark accuracy, as well as some architectural details. This will help choose a model based on the application or dataset it will be used with. In addition, a database-based category-by-category research survey is presented to provide insight into the similarities and differences among them and potential directions for future work. In addition, Open issues and challenges are discussed and potential solutions are offered in this paper. It also discusses the upcoming FER trends that are either currently under investigation or are yet to be. This is a burgeoning but difficult area of research with numerous additional potential applications that could be further investigated through its developments.

Future Enhancement:

- Robotics for enhancement in human-machine interaction
- Crime control
- Psychological research
- Security Surveillance

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