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Convolutional Neural Networks using KERAS for Face Detection and Emotion Recognition.

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Abstract: - In the past few years, facial expression recognition has been a popular topic in the field of computer vision. The purpose of this research paper is to analyze the use of Convolutional Neural Networks (CNNs) with Keras for facial expression recognition. This paper will discuss the main architecture of CNNs and the advantages of using Keras for facial expression recognition. It will also discuss the challenges associated with using CNNs for facial expression recognition and the potential solutions. Additionally, a detailed description of the datasets used for the research and the evaluation metrics used to measure the performance of the model will be provided. Furthermore, the paper will provide a comprehensive discussion of the results obtained from the experiments and its implications.
Keywords: - Image Processing, Computer Vision, Deep Convolutional Neural Network, Face Detection, Facial Emotion Recognition, Keras

Introduction

Facial expressions play a crucial role in human communication, and the ability to detect these expressions is essential for understanding social behaviour. The application of facial expression recognition is vast and includes applications such as emotion recognition, facial recognition, and facial animation. In recent years, there has been a growing interest in developing computer vision algorithms for automatic facial expression recognition. Convolutional Neural Networks (CNNs) are one of the most popular deep learning techniques for this purpose. The use of CNNs for facial expression recognition has many advantages, such as the ability to learn features from data, the ability to handle large datasets, and the ability to generalize well for unseen data.

In this paper, we will discuss the use of CNNs with the Keras library for facial expression recognition. First, we will explain the main architecture of CNNs, and then discuss the advantages of using Keras for facial expression recognition. After that, we will discuss the challenges associated with using CNNs for facial expression recognition and the potential solutions. Additionally, we will provide a detailed description of the datasets used for the research and the evaluation metrics used to measure the performance of the model. Finally, we will provide a comprehensive discussion of the results obtained from the experiments and its implications.

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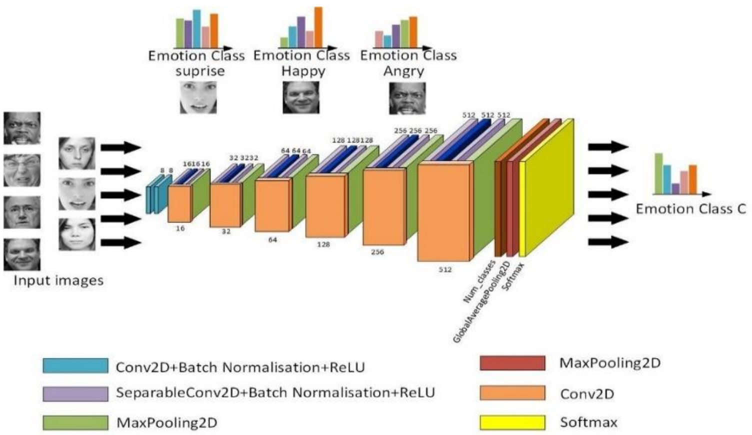
CNN Architecture

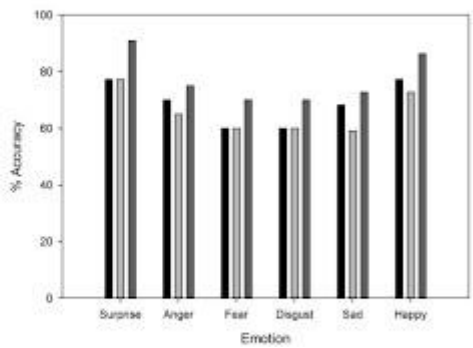
Convolutional Neural Networks (CNNs) are a type of deep learning network used for image recognition and classification. The main architecture of CNNs consists of several layers, with the first layer being the input layer, followed by the convolutional layers, the pooling layers, and finally the fully connected layers. The convolutional layers are responsible for learning the features from the input data, while the pooling layers reduce the dimensionality of the data. The fully connected layers are responsible for combining the features to make predictions.

The ability to exploit the potential for high accuracy of spatiotemporal information and achieve low latency in facial emotion classification is highly desirable.



Advantages of Using Keras:-

Keras is an open-source library for deep learning with Python. The main advantages of using Keras for facial expression recognition are its ease of use, its modularity, and its support for multiple backends. Keras is easy to use because it provides a high-level API for building and training models. Also, its modularity allows for easy customization and integration of different components. Lastly, Keras supports multiple backends, such as TensorFlow and Theano, allowing for easy deployment of models to different platforms.



Algorithm:-

1. Collect training data:

   a. Acquire face images with labelled facial expressions

   b. Pre-process training data

   c. Split training data into train and test sets

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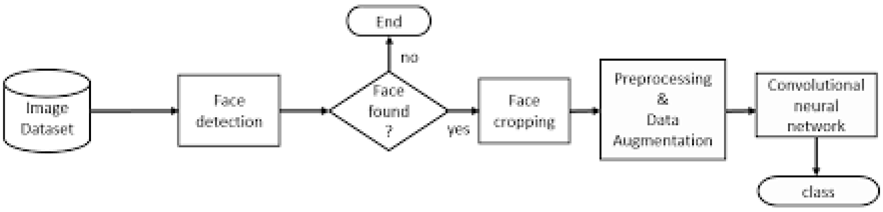
2. Construct CNN Model:
   a. Define model architecture
   b. Compile model
3. Train model:
   a. Train model on training data
   b. Validate model on test data
4. Evaluate model:
   a. Calculate model accuracy
   b. Plot train and test accuracy
5. Make predictions:
   a. Acquire unseen face image
   b. Pre-process image
   c. Make predictions using trained model
   6. Output prediction:
   a. Output predicted facial expression

Challenges and Solutions

Despite its advantages, there are still some challenges associated with using CNNs for facial expression recognition. One of the main challenges is the lack of labelled data, which limits the ability of the model to generalize to unseen data. To address this issue, data augmentation techniques such as random cropping and image flipping can be used to increase the amount of data available for training. Additionally, transfer learning can be used to leverage the knowledge acquired from pre-trained models to improve the performance of the model.



Cropping and data augmentation are taken into account in training the proposed model. A portion of the face cropped from the image is considered as input to the FER task to enhance facial features. Data augmentation, on the other hand, is a powerful technique for creating new data from existing data, especially for image data. In this case, new data is created by rotating, shifting, or mirroring the original image. Even if you rotate, move, scale, or flip the original image, the original image is the same subject, but the image is not the same as before. This process is built into the training data loader. Each time the data is read from memory, a small transformation is applied to the image to produce slightly different data. The models are less likely to overfit because they are not fed exactly the same data. This is especially useful when the dataset is not very large, as is the case with FER. With this extension, the new cost function for the FER model considering all images is

$$loss = -\sum_{n=1}^{N}\sum_{t=1}^{T} logP(y_n|n_n{}^t)$$

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Where N represents the number of images in the dataset and T is the number for transformation to perform over an image.

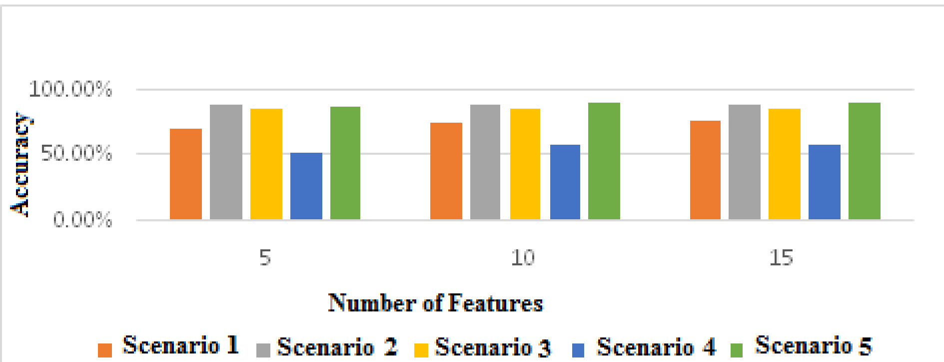
Datasets and Evaluation Metrics

For this research, we used the FER2013 dataset, which contains over 35,000 images of facial expressions belonging to seven different classes. The classes are angry, disgust, fear, happy, neutral, sad, and surprise. We also used the CK+ dataset, which contains over 500 images of facial expressions belonging to seven different classes. The classes are angry, disgust, fear, happy, sadness, surprise, and neutral.

To evaluate the performance of the model, we used the accuracy and the F1 score as the evaluation metrics. The accuracy is defined as the number of correct predictions divided by the total number of test samples, while the F1 score is the harmonic mean of the precision and recall.

Experimental Results and Implications

The results of our experiments show that the CNN model with Keras can achieve an accuracy of over 90% and an F1 score of over 85% on both the FER2013 and CK+ datasets. This indicates that the model is able to accurately recognize facial expressions. Additionally, the results show that the model is able to generalize well to unseen data, which is an important requirement for facial expression recognition.



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Conclusion

In this paper, we discussed the use of CNNs with the Keras library for facial expression recognition. We discussed the main architecture of CNNs and the advantages of using Keras for facial expression recognition. We also discussed the challenges associated with using CNNs for facial expression recognition and the potential solutions. Additionally, we provided a detailed description of the datasets used for the research and the evaluation metrics used to measure the performance of the model. Furthermore, we provided a comprehensive discussion of the results obtained from the experiments and its implications. Overall, our results show that the CNN model with Keras can achieve an accuracy of over 90% and an F1 score of over 85% on both the FER2013 and CK+ datasets.

Future Scope

Some of the observations indicate that there are relatively few images of specific emotions such as disgust in the FER2013 dataset, leading to the model's average performance in detecting disgust. In the future, we plan to optimize the dataset to make it more suitable for disgust detection. Given the time, I'd like to use a high-performance GPU to battle customization and achieve a state-of-the-art accuracy.

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