Convolutional Neural Network

Shrutika Adole., Prof. K. P. Barabde

College of Engineering and Technology, Akola

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ABSTRACT

Convolutional Neural Network forms the base of all computer vision applications. Uses like self-driving cars, object recognition, face recognition, etc. Simple neural networks struggle with images because they are slow at training and processing and have a large number of parameters. To overcome these issues, we use Convolutional Neural Networks.

Keywords: Convolutional Neural Networks, Deep Learning, Image Classification, Feature Extraction, Neural Architecture, Artificial Intelligence, Computer Vision, Deep Neural Networks, Image Processing, Machine Learning, Machine Vision, Pattern

INTRODUCTION

Convolutional Neural Network is a type of deep learning use for structured data like images. CNN is a part of computer vision that allows machines to automatically learn and find features from images, used in self-driving cars, image sorting, object detection, or face detection. In normal neural networks, images take a long time to process, so we use CNNs for faster learning and performance.

LITERATURE REVIEW

Convolutional Neural Network (CNN) is one of the best models in deep learning and has attracted a lot of interest from both industry and academia in recent years. CNN uses artificial neural networks with modern deep learning strategies and is a type of feed-forward neural network that can find features from data using convolution structures. CNN combines feature finding and classification into one model, which is a big advantage. Its key features like local connections, shared weights, and downsampling for reducing dimensions make it one of the most important algorithms in deep learning.

METHODOLOGY

Convolutional Layer: A convolutional layer is a part of a neural network that applies a convolution operation to input data. The convolution process uses a filter or kernel that moves over the input, multiplying each element and adding the results to make a feature map. This process helps the network recognize patterns like edges, textures, and shapes in images. It is responsible for finding edges or features in images. The good performance of CNNs is mainly because of the convolutional layer.

Activation Function: Activation functions in artificial neurons work as switches that determine whether a neuron should become active by adding up all of the inputs. An activation function is dependent on the input. Different neurons become active in response to various inputs, which influences subsequent neurons and ultimately results in the output. By transmitting data from the input layer to the final output layer, we obtain the ultimate result. Non-linear activation functions are necessary in order to utilize various hidden layers, as all computations would be linear without them. Non-linear activation functions help uncover complex data relationships since real-world data is not linear. We require activation functions for this reason.

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Pooling Layer: In CNNs, the pooling layer is utilized to minimize the size of input feature maps while preserving the most crucial data. The features inside the coverage area of each two-dimensional filter are summarized for each channel. The pooling layer shrinks a feature map's size or sample count. Because there are fewer factors for the network to manage, processing speeds up. The result is a map of pooled features. There are two types:

1. Max Pooling: This technique takes a certain convolved feature and extracts its greatest value.

2. Average Pooling: Ascertains a certain convolved feature's mean value.

Fully Connected Layer: In a fully connected layer, each neuron is connected to every other neuron in the layers above and below, much like in an artificial neural network. In order to learn how to link the detected characteristics to a label, the fully connected layer must first classify the features into a category. We refer to the connections between neurons as weights or parameters. The model must be taught these well-trained parameters. Fully linked layers are therefore used for learning how to link features to certain categories in addition to categorization.

RESULTS

Convolutional Neural Network is AI technology that lets computers understand and label images. It is used in fields such as: Image Classification, Object Detection, Segmentation, Generation Real-world examples include self-driving cars, face recognition, and medical image analysis.

DISCUSSION

Convolutional neural networks can efficiently extract features from complex images and perform well in image recognition tasks. In the convolutional layer, CNNs share weights, which lowers the model's complexity and training time. CNNs rely on the information provided to them. For the model to be trained, they need a sizable dataset. Overfitting may occur if the dataset is small or uneven. Additionally, CNNs' decision-making process isn't always transparent.

CONCLUSION

This study provides a comprehensive overview of convolutional neural networks in deep learning and their significant contribution to picture classification and identification challenges. The fields of image processing and computer vision have been transformed by convolutional neural networks. CNNs have excelled in several fields thanks to their capacity to automatically identify characteristics and recognize intricate patterns. There are still issues, though, and research is being done to improve their dependability and performance.

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