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A Study on Improved Deep Learning Structure Based on DenseNet

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ABSTRACT

The existing image-related deep learning research methods are conducted through algorithms based on feature identification and association, but there are limits to their accuracy and reliability. These methods are inefficient for artificial neural networks to extract features and learn because of the loss of spatial information in the process of removing background and flattening images and have a limit on increasing accuracy and reliability. The deep learning algorithm applied in this study was based on the DenseNet neural network which is recently the best in performance and accuracy, and its architecture was improved with a focus on increasing the learning performance. As a result of the experiment, both speed and accuracy of learning data were more increased than the existing DenseNet architecture, which means to diagnose more images than the existing methods within the same amount of time.

KEYWORDS

AI, Artificial Neural Networks, CNN, Deep Learning, DenseNet, MLP, ResNet

INTRODUCTION

Recently, the government and many companies have been providing various forms of technologies and services using artificial intelligence image and video recognition etc. with big data as the artificial intelligence studies are actively progressed in the society such as government, business, culture and education. Of them, a diversity of technologies have been emerged using artificial intelligence, and these technologies provide more advanced services. Every technology using artificial intelligence requires higher accuracy and reliability, and accordingly, a lot of studies have been developed to increase rapidity and accuracy.

Deep learning uses big data, where the larger the amount of data needed is grounds for increasing accuracy and reliability. Also in relation to similar images, the more diverse the comprehensive analysis collating various environmental factors and related data and the data distribution is, the better the result appears.

In addition, there could be situations where the accuracy and reliability of recognition a little bit declines depending on the depth of a hidden layer even if using deep learning, and there is also a limit that could not know which form of deep learning model should be applied to the image type to be recognized because various experiments are insufficient.

There was a prediction that basically the deeper the hidden layer is the more features are extracted and the higher the reliability and accuracy of deep learning would be, but it is not the case in the

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actual result (Du et al., 2007; Ehsanirad & Sharath Kumar, 2010; Schmidhuber, 2015). For example, when updating weights performed in the deep learning operations, there could be a gradient vanishing problem of losing the meaning of weight adjustment in the deep neural networks, and if it becomes too deeper, the weights are not almost adjusted by weight update, so there is a problem that the propagation of the intended result values does not work well.

In this study, accordingly, by reflecting the present deep learning trend, the deep learning architecture which has primarily used in the general structure is improved and applied to maintain and enhance performance compared to implementation, and also it is suggested an architecture that could prevent the phenomenon where the existing characteristic is vanished or becomes unclear by combining the characteristic of the previous phase with the characteristic to be moved to the next phase even if the depth of hidden layers is extended.

In addition, an experiment for comparing the deep learning architecture suggested with the existing DenseNet architecture is carried out to conduct performance evaluation. In the experiment, about 500 learning images are used to carry out with a focus on indicators such as the learning error rate, learning accuracy, the number of learning data per second and learning accuracy per second to compare the result.

BACKGROUND

The neural network model grown so quickly due to advancement of algorithm and hardware for several years has now more increasing reliability than the existing classification method based on low-level features and is established as a foundation for deep learning. With this background, new models such as CNN which is a model for image recognition and learning have been emerged every year. Therefore, this chapter would like to introduce MLP, CNN, ResNet and DenseNet, which are popular algorithms used for image recognition and learning, and identify their merits and demerits, and take an overview of the future development.

MLP, which stands for multilayer perceptron, was created based on the idea of the artificial neural networks that emulate human brain structure, and it means artificial neural networks that mathematically model the mechanism of neurons, which are human nerve cells, activities (Schmidhuber, 2015). Understanding MLP needs to understand the single perceptron model first. Single perceptron is the first artificial neural network model, which delivers multiple signal data into input and outputs a single signal. This is similar to that neurons transfer information through electrical signals. Also, in the perceptron, weight () has a role of dendrite or axon taking on the role of transmitting signals in the neuron. The weights () mean weighted values which are given to respective input signals, and it outputs 1 when the sum of signals in the calculation with input signals exceeds a specified threshold. A unique value is given to each input signal, and the greater the weight is the more significant the signal is considered. Figure 1 shows a single perceptron model.

The $f(x)$ means that multiplies input values X by weights W and then adds them. The $f(x)$ made by adding b to the sum is entered into the activation function to compute an output value. In other words, it starts with W values set arbitrarily, inputs into the perceptron model, and keeps improving the W values when doing wrong classification. This principle of perceptron is progressed repeatedly until classifying all learning data correctly, so it is a suitable algorithm when the learning data is linearly separated.

However, multilayer perceptron, in which a number of perceptron's are connected, is emerged in order to solve various complex problems such as XOR that is a nonlinear problem which could not be solved simply by a single perceptron. MLP is to solve problems by constructing a number of single perceptron on multiple layers. In other words, it is an idea created to analyze geometric information such as exclusive logic operation which could not be solved by a single perceptron. For MLP, its structure could be described as input and output layers exist and a hidden layer is located between