Local Binary Pattern Network (LBPN)

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BACKGROUND

Convolutional Neural Networks (CNN) have had a notable impact on many applications. Modern CNN architectures such as AlexNet, VGG, GoogLetNet, and ResNet have greatly advanced the use of deep learning techniques into a wide range of computer vision applications. These gains have surely benefited from the continuing advances in computing and storage capabilities of modern computing machines. Memory and computation efficient deep learning architectures are an active area of research in machine learning and computer architecture. Model size reduction and efficiency gains have been reported by selectively using binarization of operations in convolutional neural networks that approximate convolution by reducing floating point arithmetic operations.

TECHNOLOGY DESCRIPTION

Researchers at UC San Diego have invented a local binary pattern networks or LBPNet that is able to learn and perform binary operations in an end-to-end fashion. LBPNet uses local binary comparisons and random projection in place of conventional convolution (or approximation of convolution) operations. These operations can be implemented efficiently on different platforms including direct hardware implementation. The result is a convolution-free, end-to-end, and bitwise LBPNet from scratch for deep learning, verified on MNIST, CIFAR-10, and SVHN. LBPNets achieve near the state-of-the-art error rates of 0.50% and 8.68% on MNIST and SVHN, respectively. Both the memory footprints and computation latencies of LBPNet are greatly improved over existing works. Due to the MAC-free design, the saving of memory size is greater than 1,000X, and the speedup is higher than 450X compared with the baseline CNNs.

APPLICATIONS

It is basic technology for automated recognition and analysis tasks from data from all kinds of sources, Including vision sensors.

ADVANTAGES

The LBP makes use of primitive binary logical operations, as opposed to expensive arithmetic operations in neural networks, that makes it 3-5x faster in hardware and/or software implementation. It also uses much less memory that making it possible to incorporate advanced deep learning capabilities in small footprint (size, cost, power) embedded systems.

STATE OF DEVELOPMENT

A working software prototype has been developed.

INTELLECTUAL PROPERTY INFO

A provisional patent has been submitted and is available for licensing.

RELATED MATERIALS

- Jeng-Hau Lin, Yunfan Yang, Rajesh Gupta, Zhuowen Tu. Local Binary Pattern Networks. 2018. arXiv:1803.07125v2 [cs.CV] - 03/22/2018

PATENT STATUS

Patent Pending

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OTHER INFORMATION

KEYWORDS

Deep Learning, Image Analysis, Image Processing, Neural Networks

CATEGORIZED AS

- **Computer**
  - Software
- **Engineering**
  - Engineering

RELATED CASES

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