Oral S11

Intelligent Digital System Designs and Biomedical Applications

Date/Time 8/4 (四) 13:30-14:30

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S11.1 13:30 — 13:42

A High-Speed Extreme Learning Machine Engine for Age-related Macular Degeneration Detection

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In this paper, a system on chip (SOC) design for the extreme learning machine (ELM) model is proposed. By training the model with optical coherence tomography (OCT) images, a classifier for detecting age-related macular degeneration (AMD) has been constructed. To simplify the hardware architecture, the general normalization is neglected, and the activation function is also replaced from sigmoid to ReLU. By reducing the calculation complexity, the area could achieve 0.36 mm2 and the accuracy reaches 89.04%. At the same time, the sensitivity and specificity could achieve 98.25% and 79.82%.

S11.2 13:42 — 13:54

Compression-Aware Projection with Greedy Dimension Reduction for Convolutional Neural Network Activations

Yu-Shan Tai, Chieh-Fang Teng, Cheng-Yang Chang, and An-Yeu (Andy) Wu
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Convolutional neural networks (CNNs) achieve remarkable performance in a wide range of fields. However, intensive memory access of activations introduces considerable energy consumption, impeding deployment of CNNs on resource-constrained edge devices. Existing works in activation compression propose to transform feature maps for higher compressibility, thus enabling dimension reduction. Nevertheless, in the case of aggressive dimension reduction, these methods lead to severe accuracy drop. To improve the trade-off between classification accuracy and compression ratio, we propose a compression-aware projection system, which employs a learnable projection to compensate for the reconstruction loss. In addition, a greedy selection metric is introduced to optimize the layer-wise compression ratio allocation by considering both accuracy and #bits reduction simultaneously. Our test results show that the proposed methods effectively reduce 2.91×~5.97× memory access with negligible accuracy drop on MobileNetV2/ResNet18/VGG16.

S11.3 13:54 — 14:06

A Low-Power Two-Lens Wireless Panoramic Micro-Endoscopy Implemented Using Voltage-Current Adjuster and 3D-PCB Stacking Technology

Sheng-Wei Hsu, Ching-Hwa Cheng, and Don-Gey Liu
Dept. of Electronic, Feng Chia University

The main purpose of this paper is to develop a low-power design technology for a wireless two-lense panoramic micro-endoscopy. The voltage current adjuster (VCA) replaces the voltage-adjust method and does not increase the additional silicon cost without using voltage converters. A built-in voltage measurement mechanism provides that the voltage level can be automatically adjusted. The system achieves a 32~68% power reduction for video decoders using VCAs. The proposed technique can reduce system power consumption without performance degradation. Scalable system functions are successfully validated by a 3D-PCB stacking technique. The 3D stacking system comparison with the conventional flatten design, with good performance, less power-consumption and small volume size.

S11.4 14:06 — 14:18

An Experience Sharing: A Panoramic-Vision Lesion-Finding Low-Power Wireless Endoscopic System Design and Implementation

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Department of Electronic, Feng Chia University

The limited field-of-image and lesion-position-loss of the endoscope are often the most problematic issues faced by junior surgeons. A battery-operation wireless four-lens panoramic-endoscopy is proposed. This design provides a panoramic vision and in-time lesion-guiding information during a surgical operation. This work contains a combination of several image processing techniques of image-stitching, viewing-synthesis, and lesion-guiding to a view. Lesion-guiding provides global positioning information and tracks the predefined lesion position during surgery. On the low-power hardware design system, the image processing encoder and decoder chips were designed by the voltage-domain, which were developed by the clustered voltage-domain technique. The technique of the designed chip is separated by two/four voltage-domain, and the voltage-scaling technique is used for each domain. The high-voltage domain maintains the chip performance and the low-voltage domain reduces the power consumption. This effective technique decreases power consumption without reducing the performance of the chip. The entire system is integrated by a personal computer, an embedded system, and image encoder, decoder chips. By applying the Multi-Vdd technique, the multiple-Vdd encoder and decoder chips can be quickly redesigned based on the power, delay-time, and gate-count optimization requirements. The power consumption of the encoder and decoder chip can be effectively reduced to 50% and 24%, respectively. The performance loss can be maintained within 5% of both designs. A wireless panoramic endoscopic system is successfully validated and demonstrated by integrated encoder and decoder chips. The whole system has been successfully validated by in vivo experiments with animals. The experimental results show that the proposed system can enhance the side-by-side image size to 155%. By our search, there is no similar work that can be as a comparison.

S11.5 🕓 **14:18 — 14:30**

Using Phase Portrait of Electrocardiography Signals to Analyze Atrial Fibrillation

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To analyze arrhythmia symptoms, such as Atrial fibrillation (AF), this study uses phase portrait as an analysis method for Electrocardiography (ECG) long-term lead. The role of AF detection method in Electrocardiography (ECG) long-term lead is also proposed. Our aim is to reconstruct the phase portrait for analyzing and extract the features of AF through the time delay of the ECG signal. This algorithm cooperates with the dispersion of the RR interval and the trajectory of the phase portrait for each P wave. The distance parameters from the trajectory are calculated, and the rule to identify the AF can be provided. The classification accuracy rate with dispersion (D) as the parameter is 70%. After adding the distance of parameters, the accuracy can be improved.