

Realtime Object Detection for 4K and 8K Endoscopes

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Motivation

- Achieve better abnormal tissue detection with Ultra High Definition (UHD) 4K and 8K endoscopes.
- Reduce miss diagnoses with machine learning algorithms
- Accelerating the machine learning computation for UHD images with FPGA

Project Description

- Task 1: Develop a Novel Hybrid Deep Neural Network (DNN) Architecture
- Task 2: FPGA Acceleration with Dynamic Attention Evaluation and Combining Structured Weights and Group Convolution
- Task 3: Training Data Augmentation for Tissue Images

Context

- Most of existing colonoscopes are based on low resolution images. With such a resolution, diverse tissues are easily confused.
- We will develop machine learning algorithms to detect abnormal tissues for UHD images
- Current algorithms can only process 2-6 fps

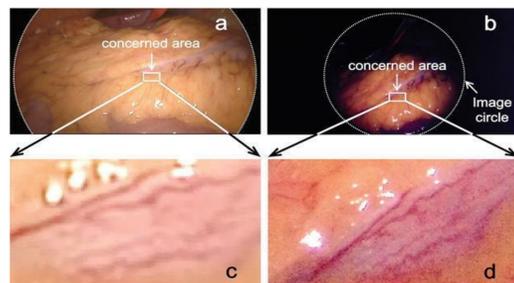


Fig 1. Comparison between 2K and 8K endoscopic images

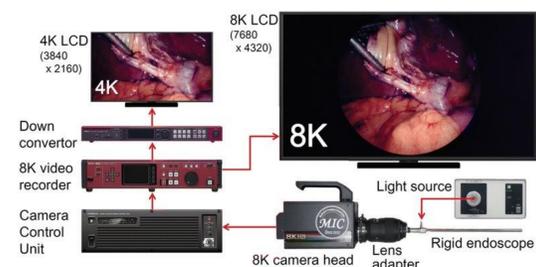


Fig 2. System Configuration for 8K UHD endoscope



Achieve Realtime Abnormal Tissue Detection for Ultra High Definition (UHD) endoscopes with Machine Learning Algorithms and FPGA Computation Acceleration

Project Deliverables

- Software: Novel Hybrid deep neural network for fast abnormal tissue detection in 4K/8K images
- Hardware: A FPGA-based system that can process UHD images in real time (25-30 fps)
- Tight collaboration with medical school
- Seek external funding support (NSF, NIH)
- The outcome of this project includes three items: the new hybrid DNN architecture, its optimized implementation in FPGA, and augmented training data set of tissue images.

Potential Impact

- The National Polyp Study showed that 70%–90% of CRCs are preventable with regular colonoscopies and removal of polyps [1].
- It is estimated that 85% of these “interval cancers” are due to missed polyps or incompletely removed polyps during colonoscopy. These misses come from both equipment factors and human errors.
- A study [2] showed an 82% decrease in interval cancer rates among colonoscopists that improved their adenoma detection rate (ADR) to the top quintile.
- This research addresses current challenges with UHD endoscopes and machine learning algorithms

References

- [1] Winawer SJ, Zauber AG, Ho MN, et al. Prevention of colorectal cancer by colonoscopic polypectomy. N England J Med 1993;329:1977–1981. Type in or place your text here
- [2] Kaminski MF, Wieszczy P, Rupinski M, et al. “increased rate of adenoma detection associates with reduced risk of colorectal cancer and death.” Gastroenterology 2017; 153:98–105.

