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NutriChip RTD 2010

FNSNF

ARE CMOS IMAGE SENSORS RELIABLE FOR BIOLOGIC APPLICATIONS?

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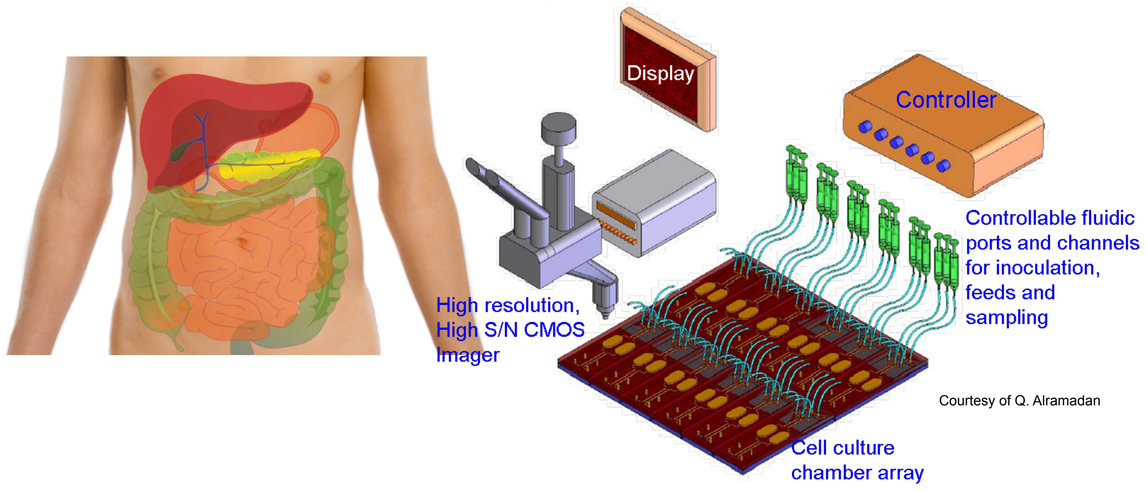
ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Project Description

The NutriChip project will develop a platform for testing the impact of dairy food digestion on the human health.

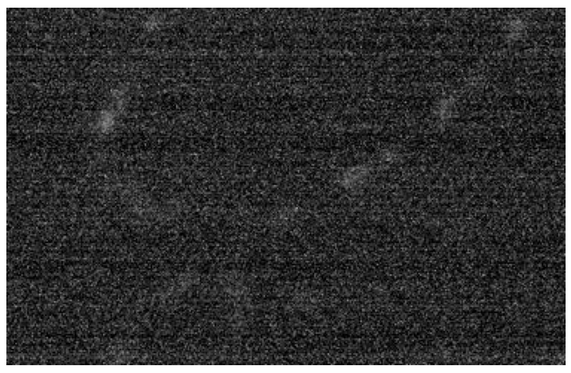


Custom Designed CMOS Camera

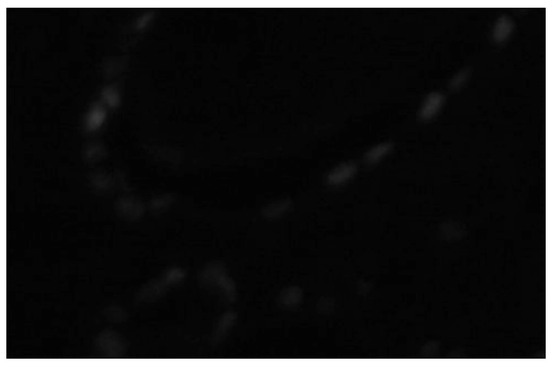
- **FPGA** Based Hardware and Software Platform
- Mid-Performance B/W Image Sensor (APTINA MT9V032)
- Camera Case with C-Mount Interface
- Computer with USB Interface

Tissue Sample (low light) Imaging

Custom Designed CMOS Camera



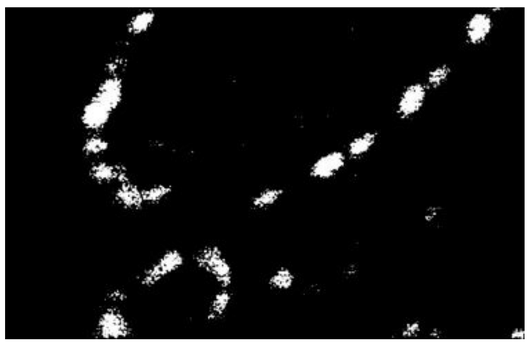
Default Camera of Nikon Ti-S Microscope (CCD Camera)



Nuclear Estrogen Receptor (ER) Expression on tissue samples obtained from cancer patients are imaged by Custom-Designed CMOS Camera.

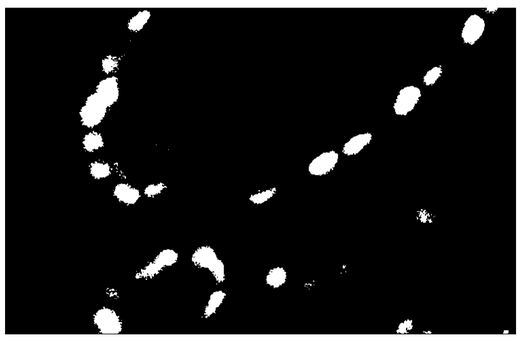
Image Processing Algorithms

Custom Designed CMOS Camera



- **Fixed Pattern Noise** Removal
- **Temporal Noise** Removal
- Auto-Thresholding and Morphological Pattern Localization

Default Camera of Nikon Ti-S Microscope (CCD Camera)



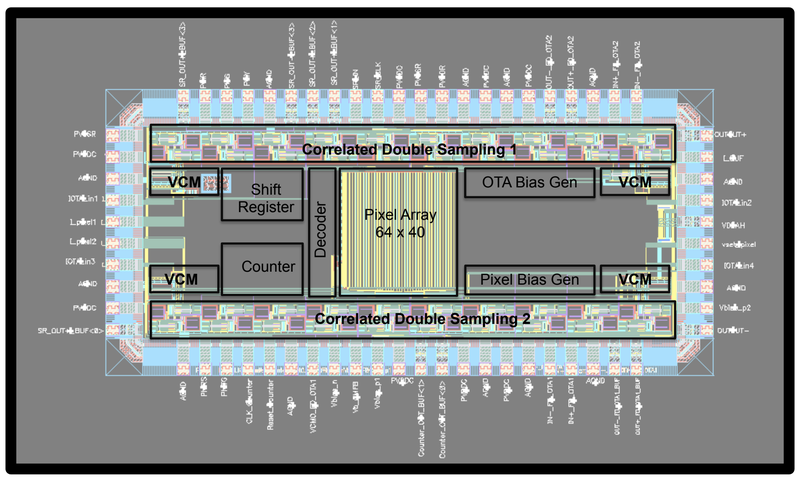
- **Temporal Noise** Removal
- Auto-Thresholding and Morphological Pattern Localization
- **Image Resizing and Registration**

CCD vs Custom Designed CMOS

		CMOS Sensor (MT9V032)	CCD Sensor (ICX274AL)
Pixel Pitch (PP)		6 µm	4.40 µm
Sensor Array		752(H) x 480(V) (Wide VGA 360k pixels)	1628 (H) x 1238(V) (2.01 M pixels)
A to D Resolution		10 bits	12 bits
Sensitivity	Min.	400mV	335mV
	Typ.	572mV	420mV
	Max.	745mV	545mV
Quantum Efficiency @665nm		%49	%55
		FPGA Based Custom-Designed CMOS Camera	Nikon DS Vi-1 Camera with Control Unit
Cost		≅1k CHF	≅14k CHF
		CMOS Images	CCD Images
Image Cropping		No Cropping	971 x 631 (# of Pixels)
Image Resizing after Registration		No Resizing	752 x 480 (# of Pixels)
Normalized White Pixel Counts		0.0338	0.0448
Correlation Coefficient		0.8222 (gray images) (strong correlation)	

G. Koklu, J. Ghaye, R. Beuchat, G. De Micheli, Y. Leblebici, S. Carrara,
Quantitative Comparison of Commercial CCD and Custom-Designed CMOS Camera for Biological Applications,
Circuits and Systems (ISCAS), 2012 IEEE International Symposium on , vol., no., pp., May 20-23 2012

Image Sensor v2



- **Technology**: UMC 0.18 µm
- **Area**: 3240µm x 1525µm
- **Resolution**: 64 x 40 Pixel Array
- **Noise Reduction:** CDS per Column
- **Column Scanning:** Shift Registers for
- **Row Scanning:** 6 bit Counter

* CDS – Correlated Double Sampling – Method Presented in ISMICT, Montreux, 2011

G. Koklu, Y. Leblebici, S. Carrara, A Switched Capacitor Fully Differential Correlated Double Sampling Circuit for CMOS Image Sensors,
Medical Information & Communication Technology (ISMICT), 2011 5th International Symposium on , vol., no., pp.113-116, 27-30 March 2011