Feature extraction from images of endoscopic large intestine

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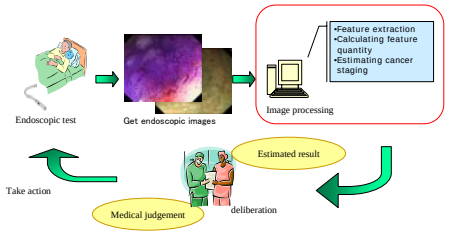
Purpose

Building diagnosis system that automatically estimates cancer staging from an each endoscopic images



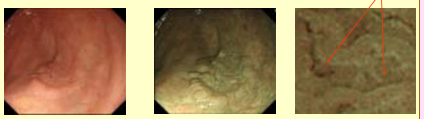
Preliminary step for the purpose

Automatic extraction of feature as a basis for the estimate

Feature extraction from NBI image

NBI(Narrow Band Imaging) system

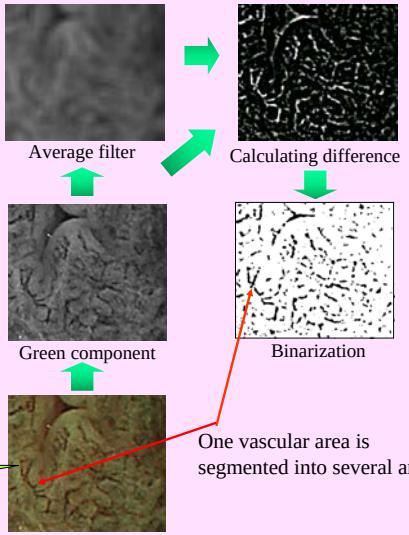
- A new feature of an endoscope
- This can observe vascular structure without stain process



A surface of large intestine | NBI image | Endoscopic NBI image

Vascular area is extracted as a basis for the estimate

Adaptive binarization



One vascular area is segmented into several areas

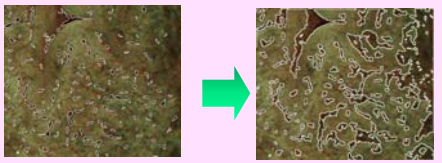
Level set method

Applying active contour model to improve segmentation.

Model : Level Set Method

Speed function : $F(x,y)=\frac{F_1(x,y)}{F_2(x,y)}$

$F_1(x,y)=\begin{cases}-1 & (I(x,y)\le T)\\ 1 & (I(x,y)>T)\end{cases}$ $F_2=1+\nabla S\otimes I(x,y)$



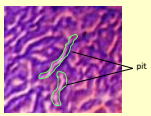
Contour of binarized result | Extracted resultc

Extracted result is not well because of unsuitable functiojn

Feature extraction from conventional image

conventional observation

Stained surface of large intestine



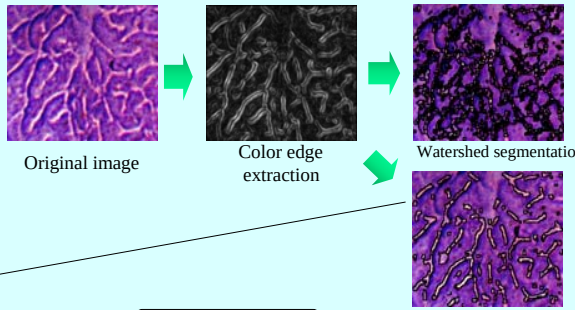
Endoscopic image

I		Round pit (normal pit)
II		Asteroid pit
IIIs		Tubular or round pit that is smaller than the normal pit
III_L		Tubular or round pit that is larger than the normal pit
IV		Dendritic or gyruslike pit
V i		Irregular arrangement and sizes of III_L, III_S, IV type pit pattern
V_N		Amorphous or nonstructural pit pattern

Doctor make a diagnosis by observing the stained surface

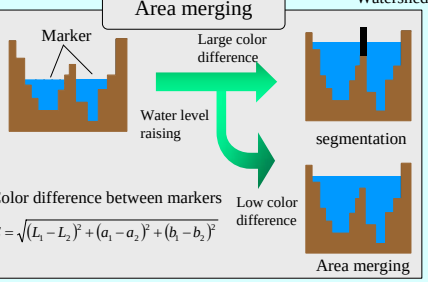
Pit pattern is extracted as a basis for the estimate

Extraction process



Original image | Color edge extraction | Watershed segmentation | Watershed + Area merging

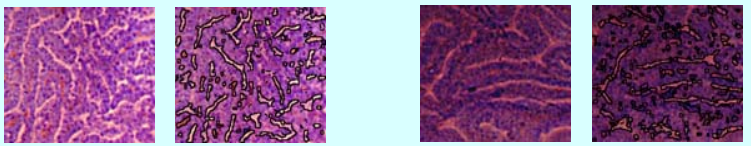
Area merging



Color difference between markers

$$\Delta E=\sqrt{(L_1-L_2)^2+(a_1-a_2)^2+(b_1-b_2)^2}$$

Extracted result and Relation between staging and pit features

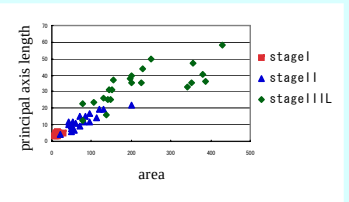


Pit patterns are well extracted from high contrast image but nonpit area is extracted too

Doctor select manually only pit areas

Pit features are calculated

Pit features : area, principal axis length, boundary length



Cluster of each stage (only three stages) is looked