Bad Pixel Location Algorithm for Cell Phone Cameras

Sergio Goma, Milivoje Aleksic – AMD

6502-16/EI 2007

AMD

Outline

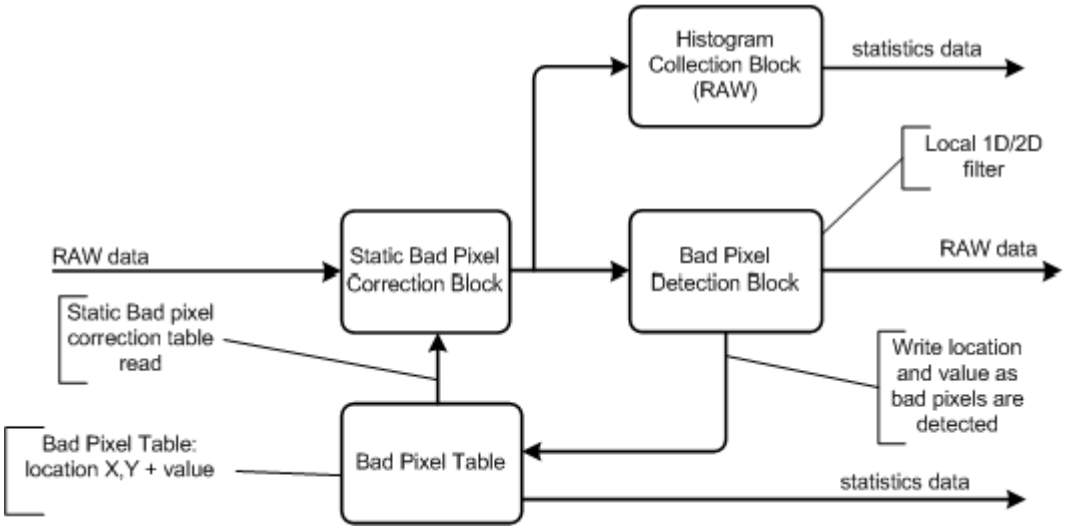
- Introduction
- Proposed algorithm
  - Implementation details
- Results
- Conclusions and remarks

Generic bad pixel detection

- Hardware implementation of the image processing data path is usually a good choice for the mobile market.
- The constrains are:
  - Power
  - Cost
  - Performance (speed, color quality)
- The color processing part

Bad Pixel Detection block

- Color constancy vs. chromatic adaptation
- 2 step color correction:
  - White point estimation
  - Chromatic transformation



Proposed algorithm

- Bad pixel location implemented in 2 phases:
  - Phase 1 - once: locate stuck-at pixels (white pixels) and pixels with excessive offset;
  - Phase 2 - iterative: locate hot pixels;

Static Pixel Defects

- Need a linear color space close to a perceptu
- For ease of implen 2D projection is us

$$X = R - \frac{B+G}{2}$$

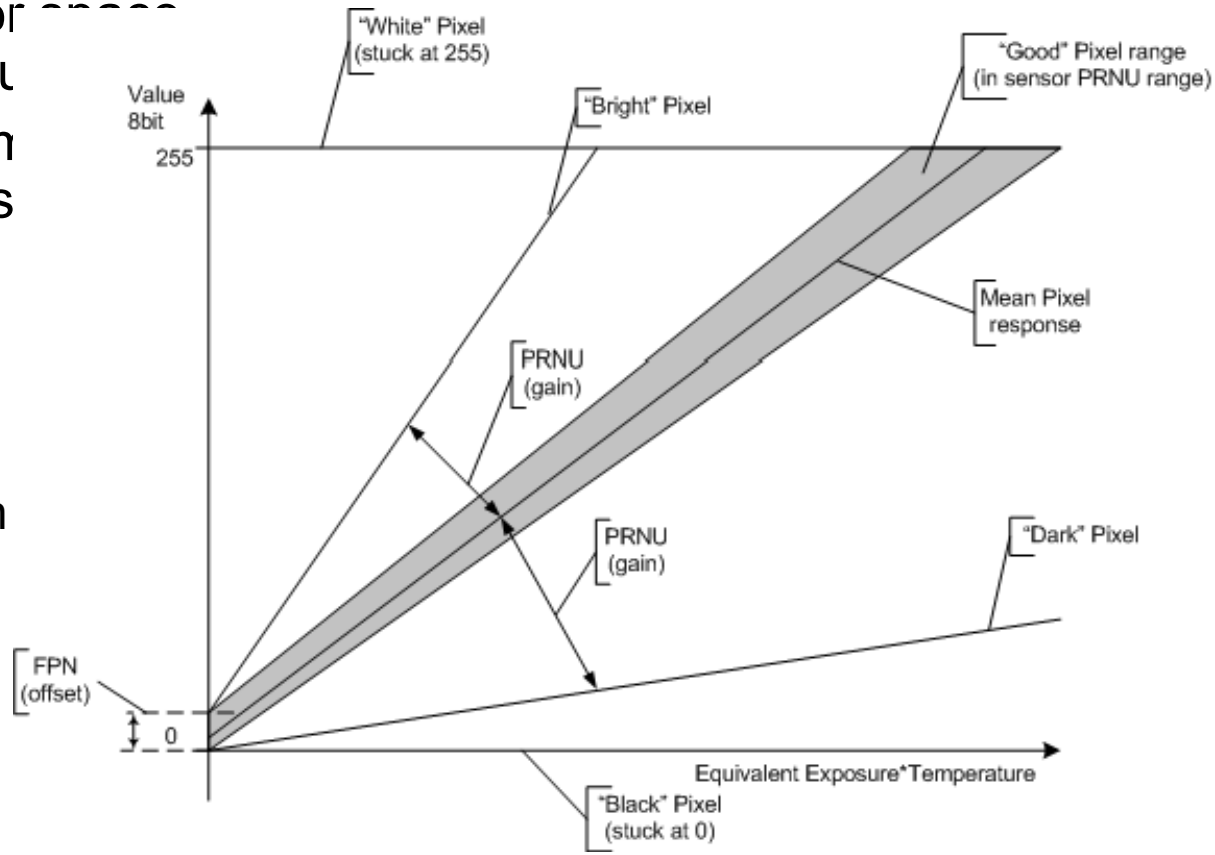
$$Y = 0.866 \cdot (G-B)$$

- Relation to HSV can characterized by:

$$Sat = \sqrt{X^2 + Y^2}$$

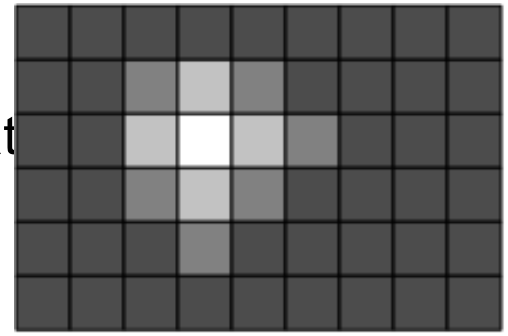
$$Hue = \frac{atg\left(\frac{X}{Y}\right)}{2 \cdot \pi}$$

$$Value = \left(\frac{R+G+B}{3}\right)$$

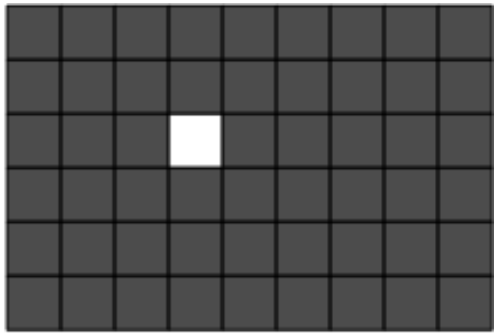


Implementation Detail: Statistics collection constraints

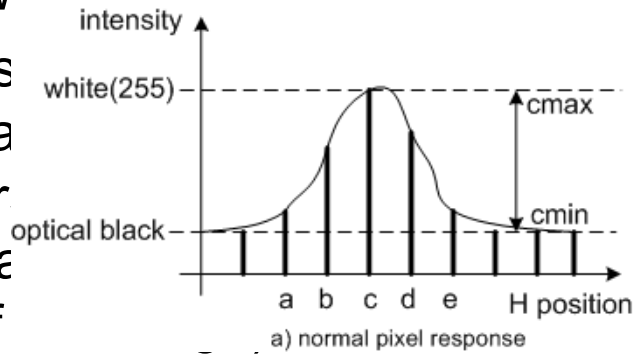
- Requirements:
  - Simple implementat
  - Linear processing
  - No memory
- Constrains:
  - Luminance (low and high)
  - Saturation (bas
    assumption tha
    saturated color
    information rela
    temperature of



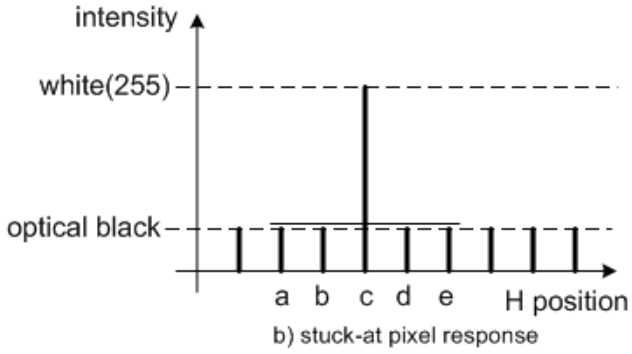
a) normal pixel response



b) stuck-at pixel response



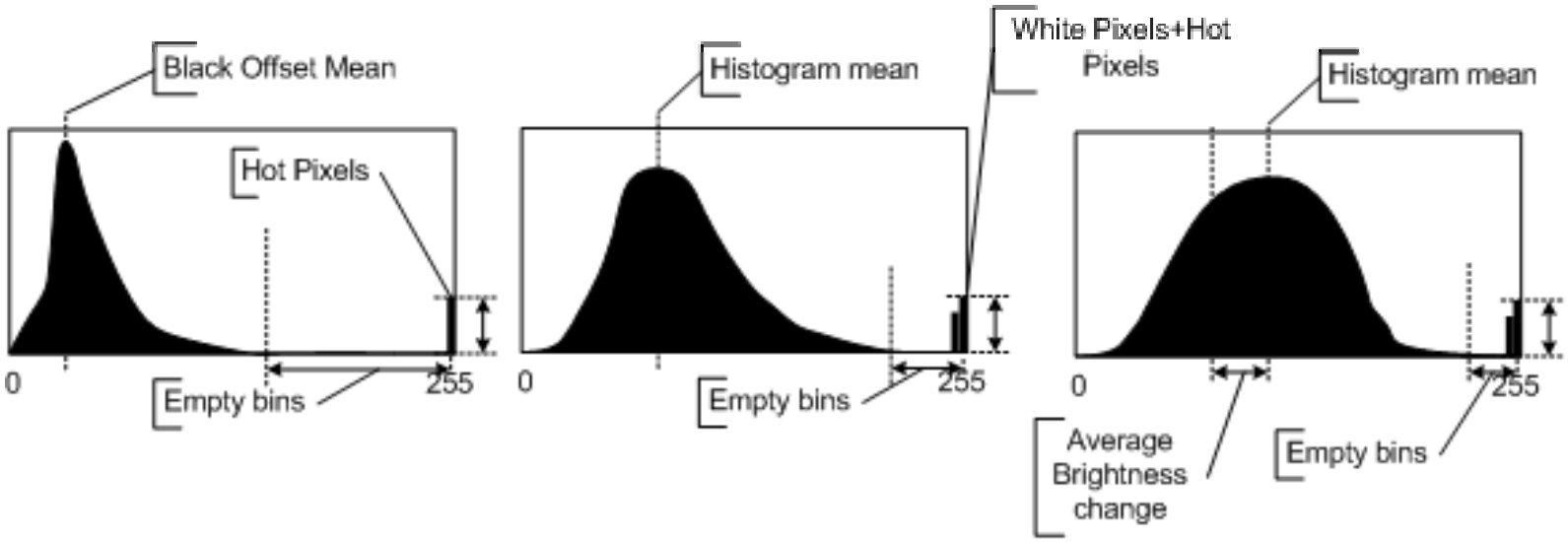
a) normal pixel response



b) stuck-at pixel response

Implementation Detail: Histogram analysis

- Advantages of using histogram with local filtering: reduced aliasing probability



a) dark frame exposure b) exposure T1 c) exposure T2

Results



a) Exposure 0, scene



b) Exposure 0, sensor covered

- Phase1: Dark exposure collection for stuck-at and high offset pixels

Results



a) Exposure t1, scene



b) Exposure t1, sensor covered

- Phase 2 step 1: Hot pixel detection

Results



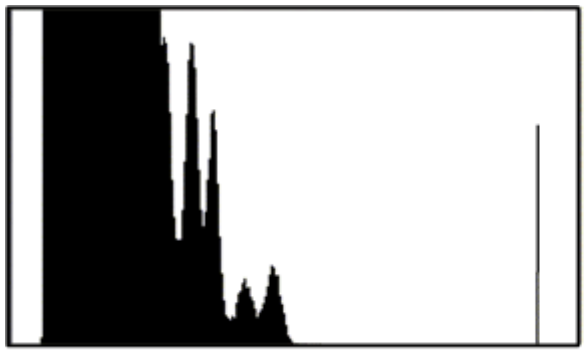
a) Exposure t2, scene



b) Exposure t2, sensor covered

- Phase 2 step 2: Hot pixel detection

Results



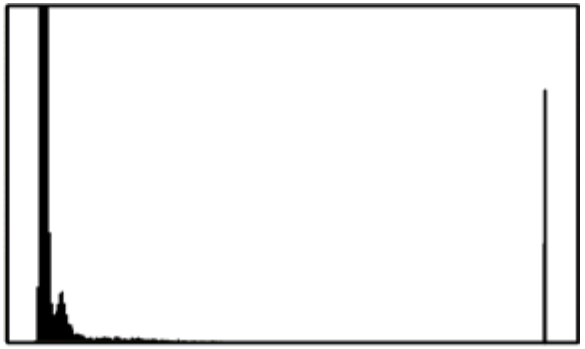
a) Exposure t1, scene



b) Exposure t1, sensor covered



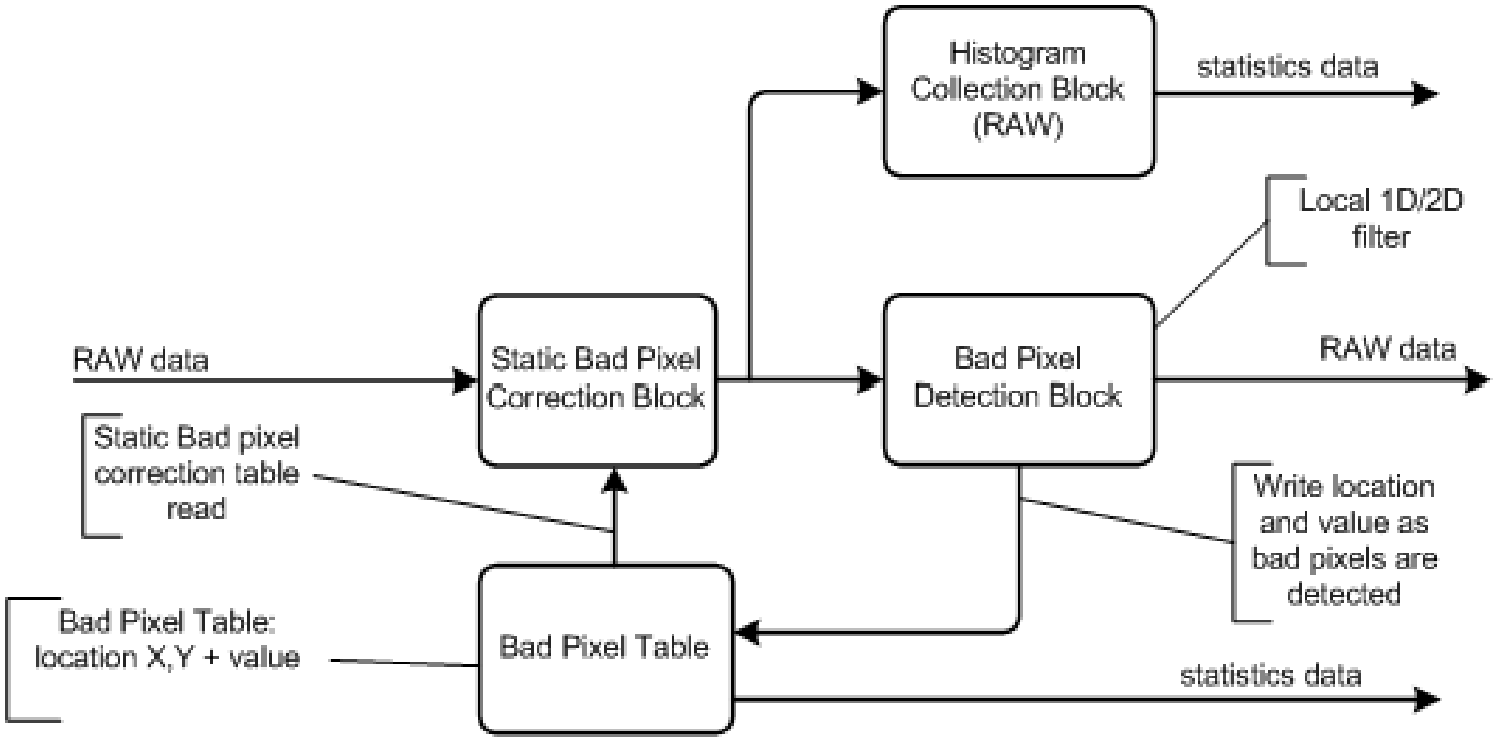
a) Exposure t2, scene



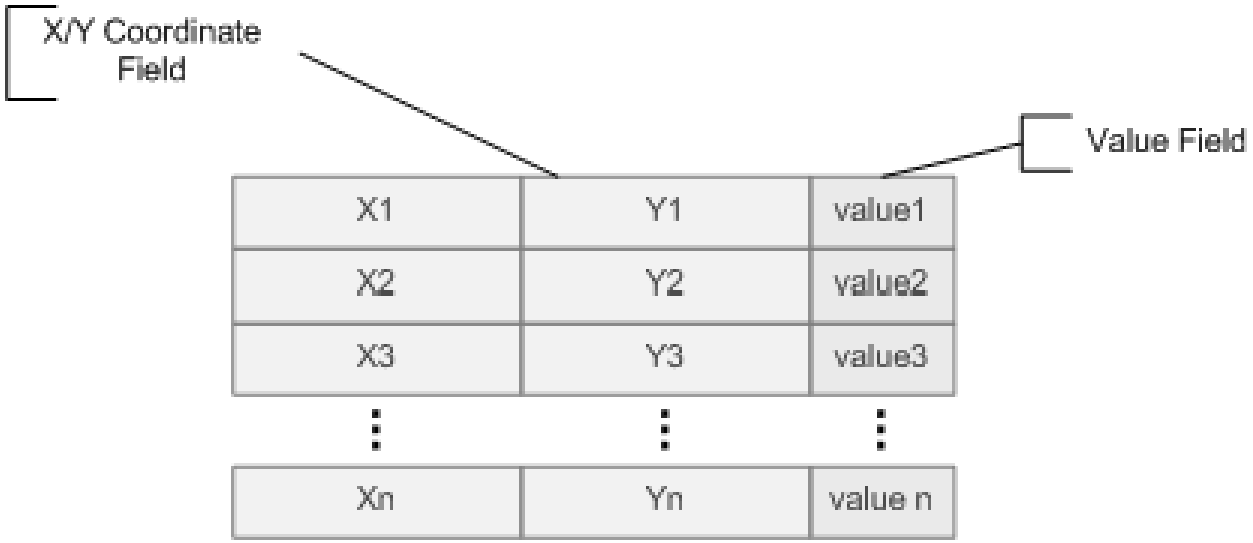
b) Exposure t2, sensor covered

- Phase 2 histograms

Implementation Example



Implementation Example: Location Data Memory



Conclusions and future work

- Bad Pixel location algorithm optimized for cell-phone cameras;
- The algorithm can run on power-on to fill the location table;
- Replacement for full image offset/gain map;

Future Work

- Using the value of the bad pixel in the bad pixel location table to predict pixel gain.