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Homework 2
Measuring the sensor noise of Tegra tablet

1. Write android code to capture a sequence of images (5 Points)

Process Involved:

- Highest and lowest gain values of the sensor was obtained. (Lowest: 100 and Highest: 1600)
- A sequence of 100 raw images were capture using the Tegra tablet. 50 of them were captured with low gain and the other 50 with high value on gain.
- The images (.dng) were transferred to Matlab.

Corrected Code Snippet:

```
Range<Integer> sstt
=characteristics.get(CameraCharacteristics.SENSOR_INFO_SENSITIVITY_RANGE);

Integer lower_sstt = sstt.getLower();
Integer higher_sstt = sstt.getUpper();

//For lower gain
requester.set(CaptureRequest.SENSOR_SENSITIVITY, 100);

//For higher gain
requester.set(CaptureRequest.SENSOR_SENSITIVITY, 1600);
```

Problems Encountered:

None

2. Process the image sequence to gather noise statistics

- The images were loaded into MATLAB as an array.
- A number of pixels were selected, over which the exercise was performed. Histogram of these pixel values were plotted.
- Mean and variance were calculated from the given equations and stored in separate arrays.

For Lower Gain:

Mean/Variance Sample

Mean	Variance
2.0000	0
1.0200	0.9800
1.0800	0.9200
1.3800	0.6200
1.8800	0.1200
2.0000	0
2.0000	0
1.9600	0.0400
2.0000	0
2.0400	0.0400

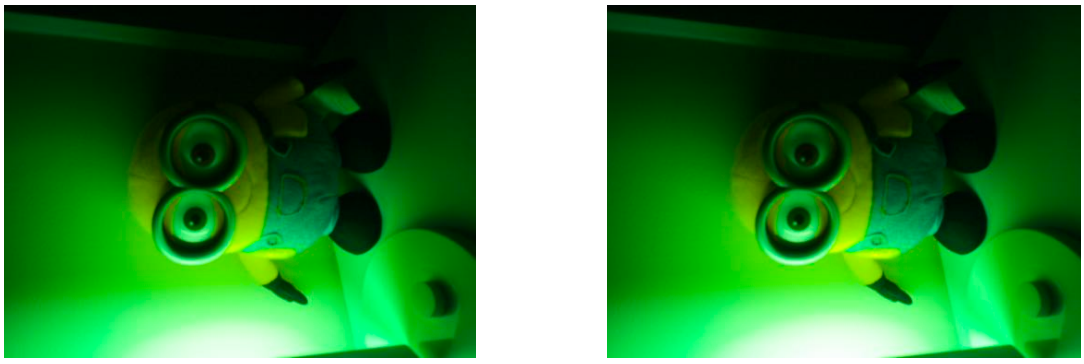


Image samples

For Higher Gain:

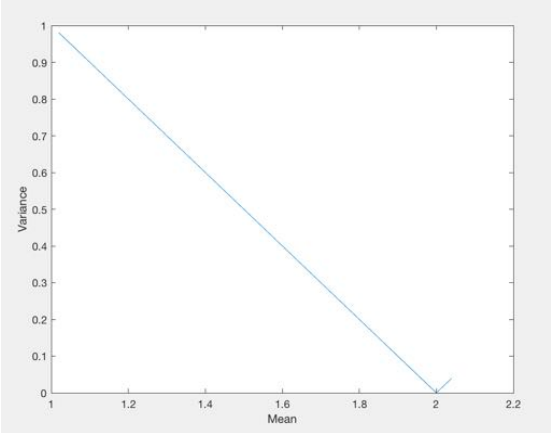
Mean/Variance Sample:

Mean	Variance
11.33	4.01
6.23	27.19
6.44	25.22
7.75	14.90
9.73	4.65
11.79	0.44
12.81	6.63
11.67	4.54
13.02	7.12
16.60	34.44

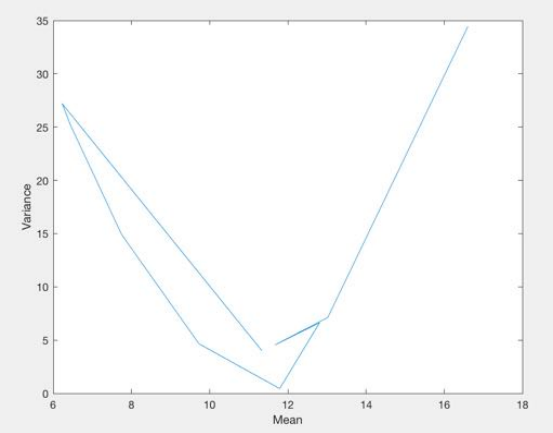
Image samples

- Variance was plotted against mean. It gives a straight line inclines to X-Axis. Slope is found to be negative.

Slope = -0.983914
Therefore, Gain = -0.983914.



Low Gain

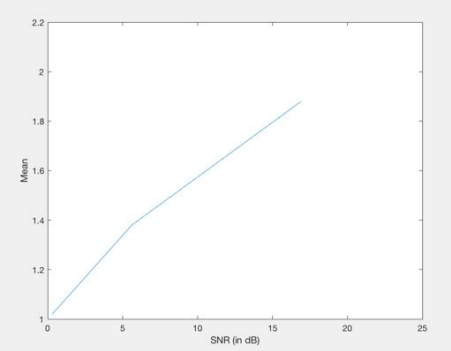


High Gain

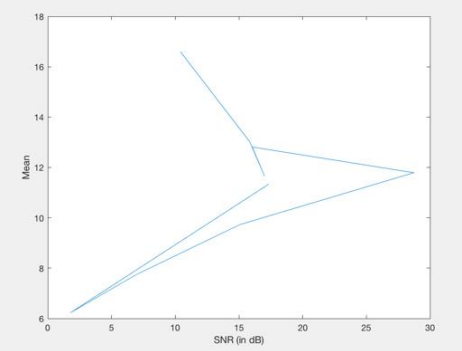
- Polyfit was used to fit a line to the plotted data. This helped in deriving the gain, read noise variance and ADC noise variance.

Read Noise Variance (σ^2_{read}) = 0.102317
ADC Noise Variance (σ^2_{ADC}) = 2.204985

- SNR vs mean pixel value plot was generated and this was observed. The following curve was obtained.



Low Gain



High Gain

Highest observed value in sample = 28.72 dB, but actual value will be much more due to the small sample size.