



INDIAN INSTITUTE OF  
INFORMATION TECHNOLOGY,  
NAGPUR

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## Digital Image Processing (ECL-415)

### Project - Pixel Binning

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*Submitted By :*

Sarthak Babra (BT19ECE028)

S Pavan kumar (BT19ECE008)

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Electronics and Communication Engineering Dept.

*Submitted To :*

Dr. Tapan Jain

Course Instructor

## Introduction

The term 'pixel binning' means taking a group of four adjacent 'pixels' (arranged in a 2 x 2 quad) on a camera's image sensor and treating them as one big 'super' pixel.

- This is done to improve image quality and reduce image noise (grain).
- It explains why our 64MP or 108MP camera phone almost always actually outputs 16MP or 27MP images, respectively, as if it combines four pixels into one, we end up with an image that's one-quarter the size.

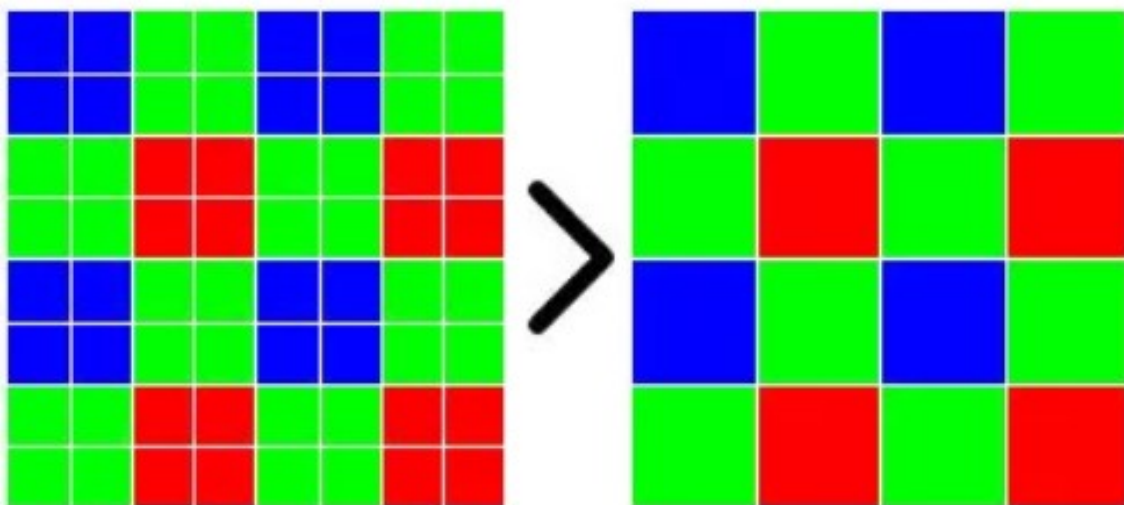
## How does it work ?

In pixel binning, the demosaicing method merges information from four pixels into one (in the case of a 4-to-1 binning), making the technology effectively an Image Signal Processor level implementation.

Let's call pixel binning what it is: It combines pixels in a

- $2 \times 2$  grid,
- $2 \times 1$  grid,
- $3 \times 3$  grid,
- or a  $4 \times 4$  grid

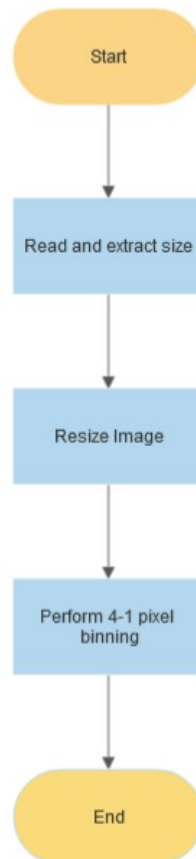
into one. Each pixel's information is now integrated into a single big Super Pixel.



Since pixels are combined or “binned” together, the effective resolution is reduced. With Pixel Binning, the overall sensitivity to light of an image sensor is improved, which makes it “see” more in darkness. Dark current noise is not reduced by binning since each pixel will contribute dark current noise to the super pixel.

### Algorithm

- Read the input colour image and convert the image to gray scale.
- Extract the size of the gray scale image.
- Create a resized image to store values of pixels after binning.
- Perform 4-1 pixel binning, i.e., taking average of 4 pixels and giving its value to a single pixel in the resized image.
- Perform the same operation as in gray scale image to each layer of colour image to get colour image after pixel binning.



## Code

```
1  clc;
2  clear all;
3  close all;
4
5  % Read the colour image
6  Img = imread('Image1.jpg');
7
8  % Convert the colour image to grayscale image
9  gray = rgb2gray(Img);
10
11 % Extract the size of the gray scale image
12 s = size(gray);
13
14 % Resize the colour image to store values of pixels after binning
15 image = imresize(Img, [(s(1)/2) (s(2)/2)]);
16
17 t1=1;
18 t2=1;
19 i=1;
20 j=1;
21 k=1;
22
23 % Perform 4-1 pixel binning for each layer of colour image
24 while(k<=3)
25     while(i<=s(2))
26         while(j<=s(1))
27             t3 = [Img(i,j,k) + Img(i,j+1,k) + Img(i+1,j,k) + ...
28                 Img(i+1,j+1,k)]/4;
29             image(t1,t2,k) = 0;
30             image(t1,t2,k) = image(t1,t2,k) + t3;
31             j=j+2;
32             t2=t2+1;
33         end
34         i=i+2;
35         t1=t1+1;
36     end
37     k=k+1;
38 end
39 subplot(2,2,2), imshow(image), title('Colour image after pixel ...
40     binning')
41 subplot(2,2,1), imshow(Img), title('Original colour image')
42 subplot(2,2,3), imshow(gray), title('Original gray scale image')
43
44 temp1=1;
```

```

44 temp2=1;
45
46 % Resize the gray scale image to store the values of pixels ...
   after binning
47 bin = imresize(gray, [(s(1)/2) (s(2)/2)]);
48 i=1;
49 j=1;
50
51 % Perform 4-1 pixel binning for the gray scale image
52 while(i<=s(2))
53     while(j<=s(1))
54         temp3 = [gray(i,j) + gray(i,j+1) + gray(i+1,j) + ...
                   gray(i+1,j+1)]/4;
55         bin(temp1,temp2) = 0;
56         bin(temp1,temp2) = bin(temp1,temp2) + temp3;
57         j=j+2;
58         temp2=temp2+1;
59     end
60     i=i+2;
61     temp1=temp1+1;
62 end
63 subplot(2,2,4),imshow(bin), title('Gray scale image after pixel ...
   binning')

```

## Result



## Conclusion

- With pixel binning, the sensor's sensitivity is greatly increased which is extremely useful in night vision applications and low light environments.
- Since, in pixel binning 4 pixels are merged into a signal one, the resolution of the image is reduced.
- The overall size is also reduced since the resolution of the image is reduced.

## Future Research

Now the challenge is that, if you want a high-resolution camera , you are likely to have a smaller pixel size. This limits the sensitivity of the camera.

This is where image binning comes to the rescue. An image binning camera is capable of mimicking a larger pixel size without having to go for a larger sensor.

## Bibliography

- Prabu Kumar. What is pixel binning – how does it work and what are its advantages? 2022
- Ben Andrews. What is pixel binning? Everything you need to know about this camera tech. 2022