

Haar-like features



Haar-like Features

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Haar-like Features



Alfred Haar

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Edge Features

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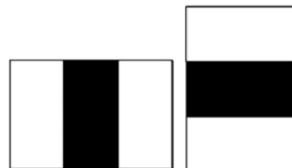
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Edge feature is when in a picture there is two parts of light and dark next to each other. For example, when a picture that contains table. At the end of table there is going to be some line which divides the table from its surrounding and that's the edge feature.

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Edge Features



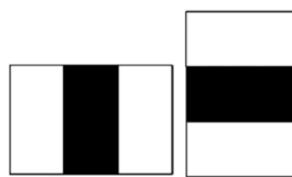
Line Features

Line feature is like a lip in a picture which it's all one object but there is one/some divider in the middle

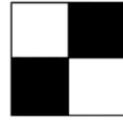
Haar-like Features



Edge Features



Line Features



Four-rectangle
Features

Haar-like Features

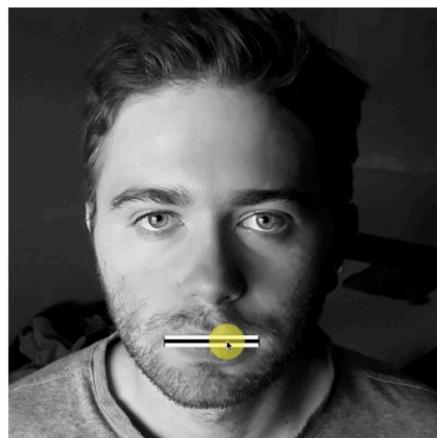


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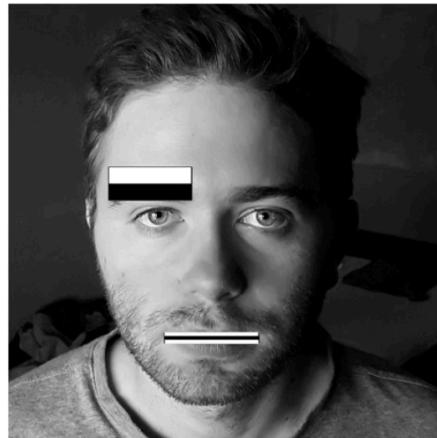
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Line feature

Haar-like Features



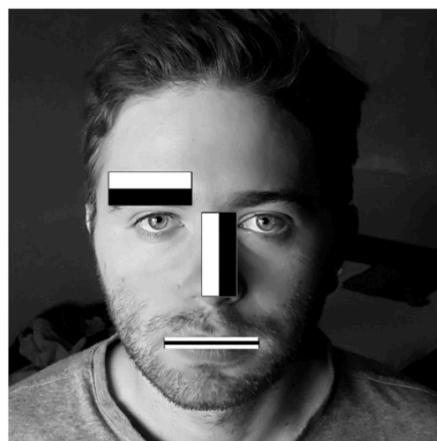
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Edge feature

Haar-like Features



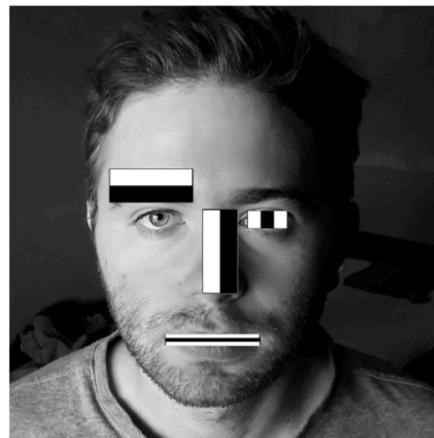
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Edge feature

Haar-like Features



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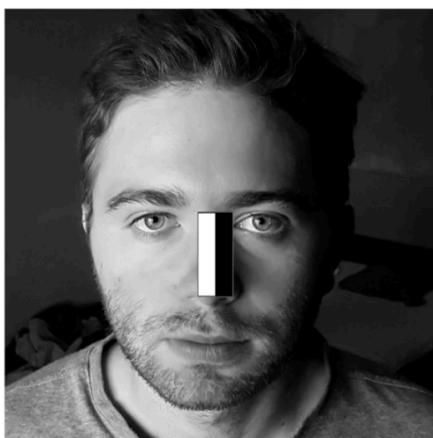
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Line feature

These features sometimes depend on the lighting, sometime on the person and so on. but in overall these features are common in most of humans.

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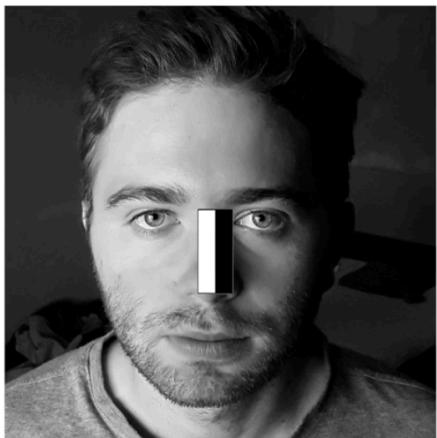


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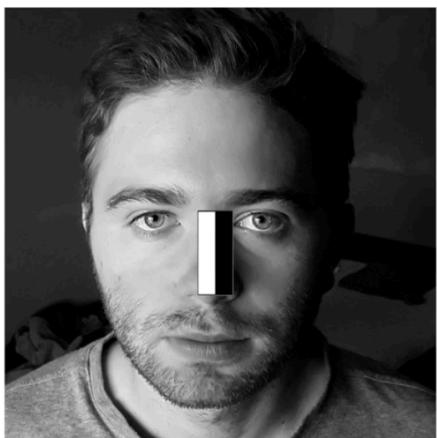
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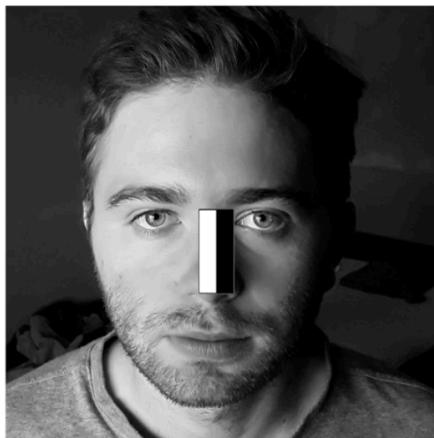


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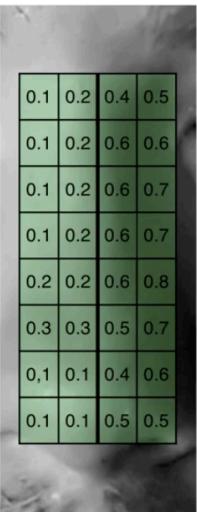
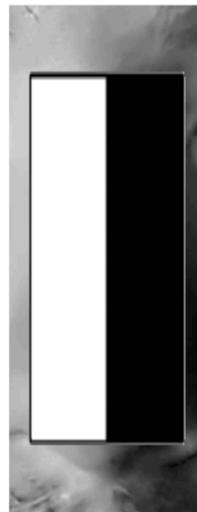
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In reality the pixels are much more smaller

Haar-like Features



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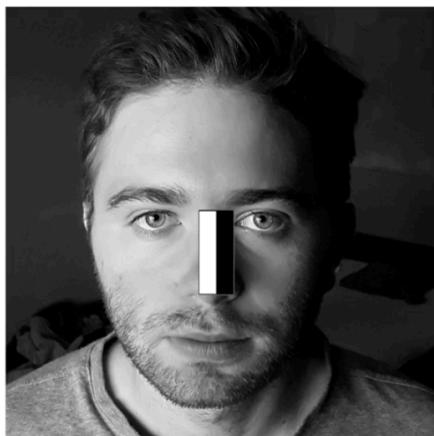


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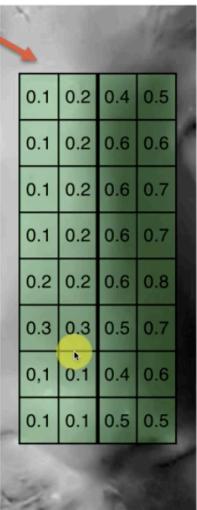
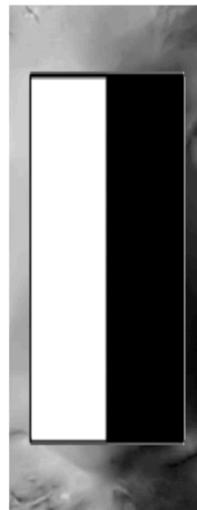
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The number is between 0 (light) and 1 (dark) remember in this picture for simplicity we wrote the normalized numbers. Of course, in reality the scales are between 0 and 256. As we can see when we go one to the right the numbers will be equal or greater than the number before.

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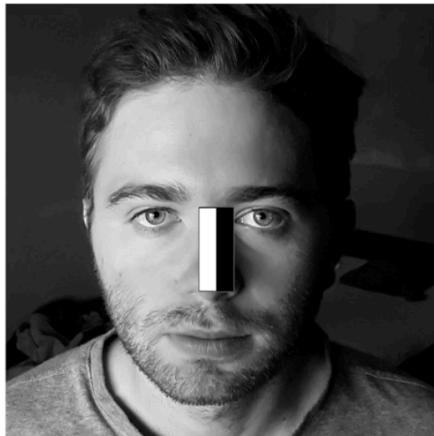


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This is the average number of the light area

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0.166



0.568

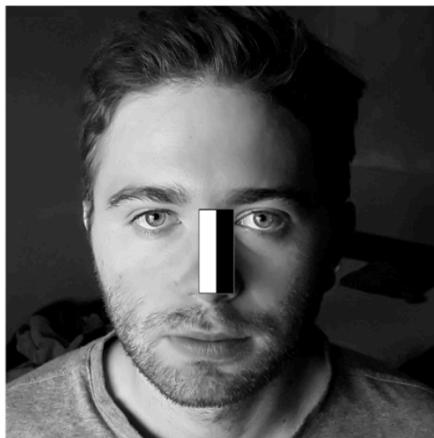
0.1	0.2	0.4	0.5
0.1	0.2	0.6	0.6
0.1	0.2	0.6	0.7
0.1	0.2	0.6	0.7
0.2	0.2	0.6	0.8
0.3	0.3	0.5	0.7
0.1	0.1	0.4	0.6
0.1	0.1	0.5	0.5

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Average number of the dark area

Haar-like Features



"JD"



0.166



0.568

0.1	0.2	0.4	0.5
0.1	0.2	0.6	0.6
0.1	0.2	0.6	0.7
0.1	0.2	0.6	0.7
0.2	0.2	0.6	0.8
0.3	0.3	0.5	0.7
0.1	0.1	0.4	0.6
0.1	0.1	0.5	0.5

$$B - W = 0.402$$

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Now it subtracts the two numbers. In a very ideal scenario the subtraction would be 1 (totally dark) – 0 (totally light) = 1 and of course this situation is not that common. that's why viola-jones has some thresholds and through the training, these thresholds are identified. For instance, for this specific feature in that position, it might identify that the minimum threshold is 0.3. so, when we get a result that is greater than 0.3 then it says yes, the Haar-like feature is present in this position in the picture

On the other hand, also using a value less than the threshold (like 0.1) will help us to actually detect the features in the pictures.

That's why threshold is really important to us because with help of them we can see if some features are present in the picture or not.