

Hough Transform

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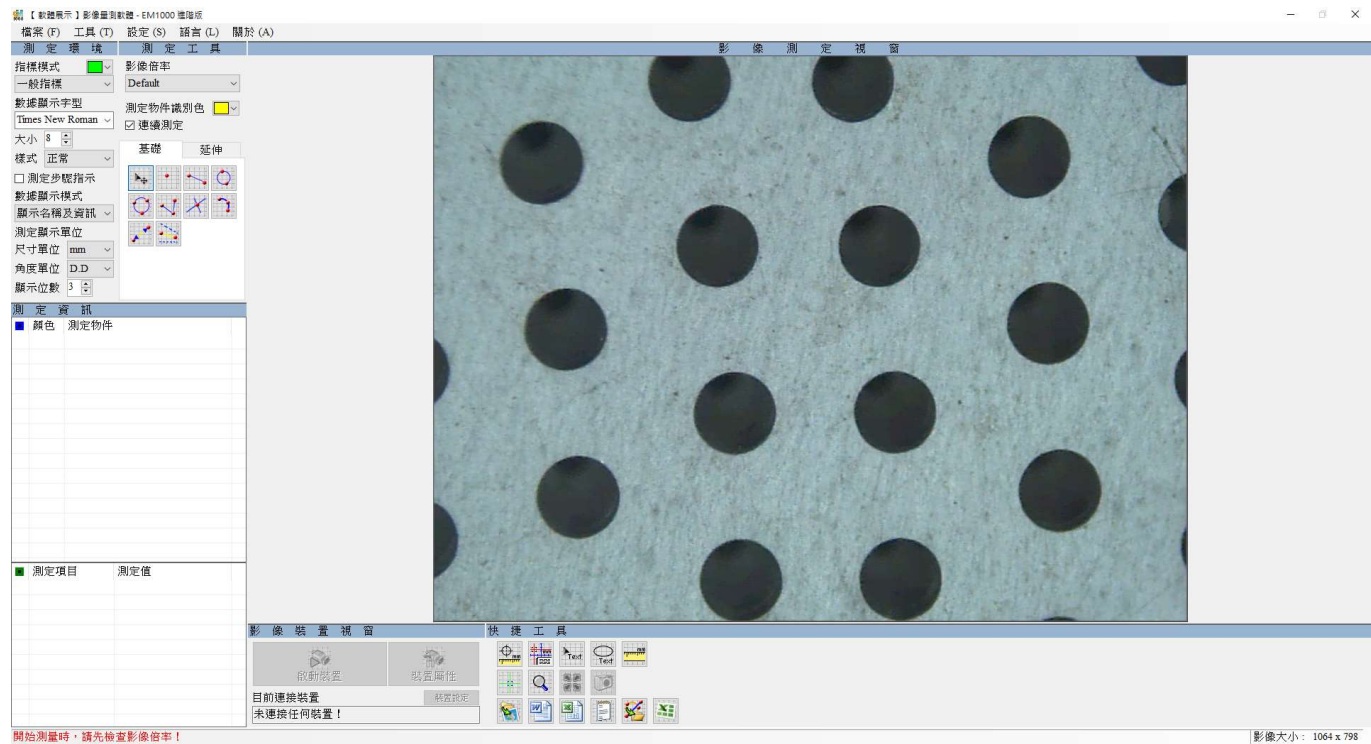
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National Yunlin University of Science and Technology**



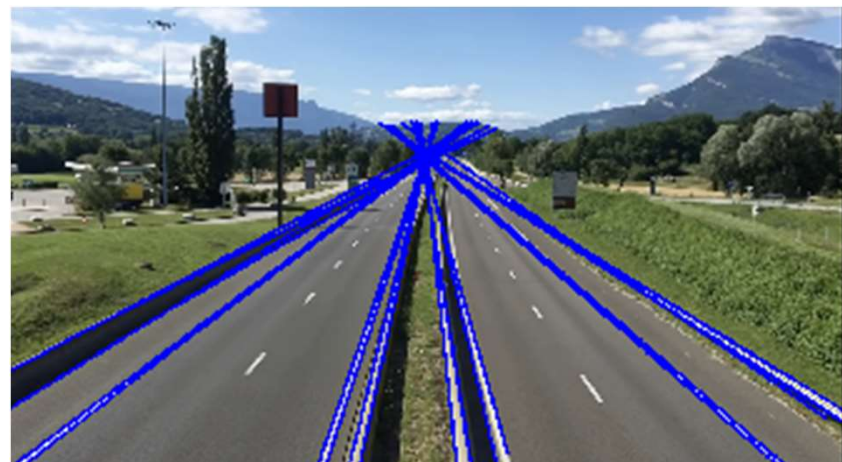
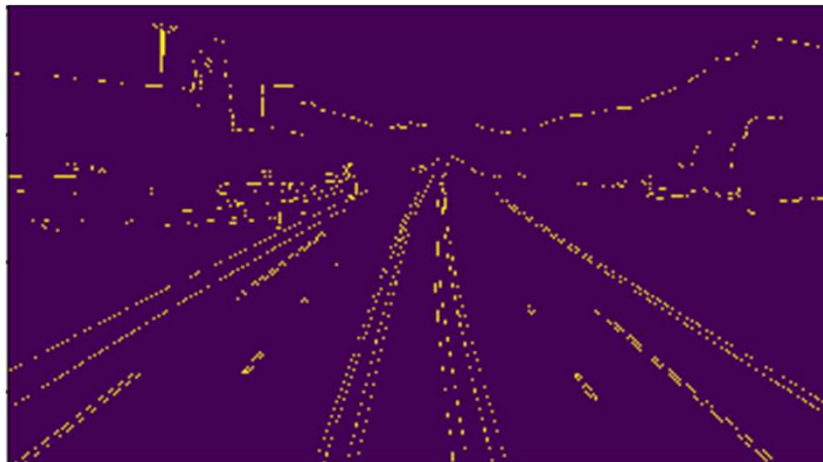
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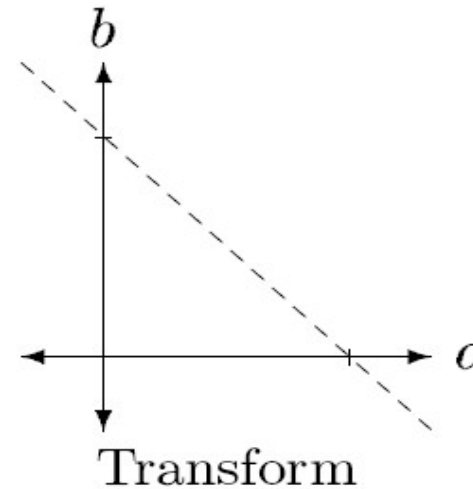
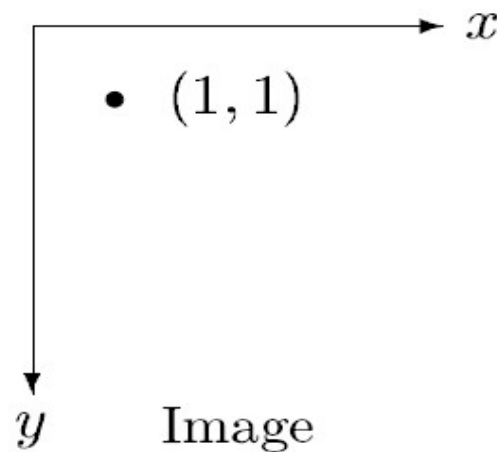
Line Detection



The Hough transform

- **Line**

$$y = ax + b$$

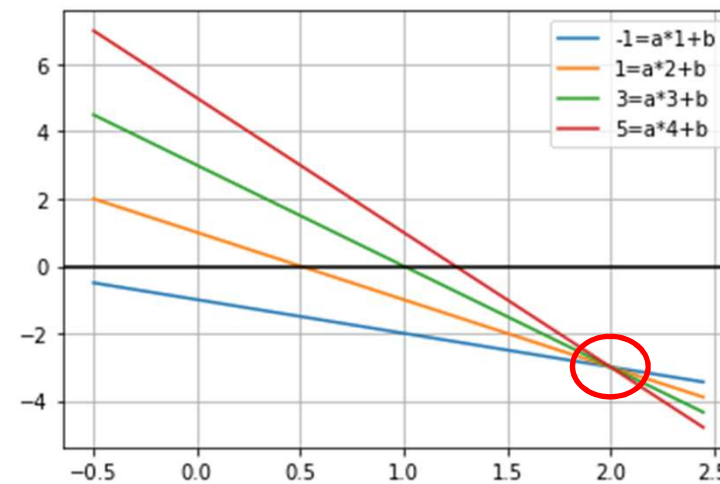
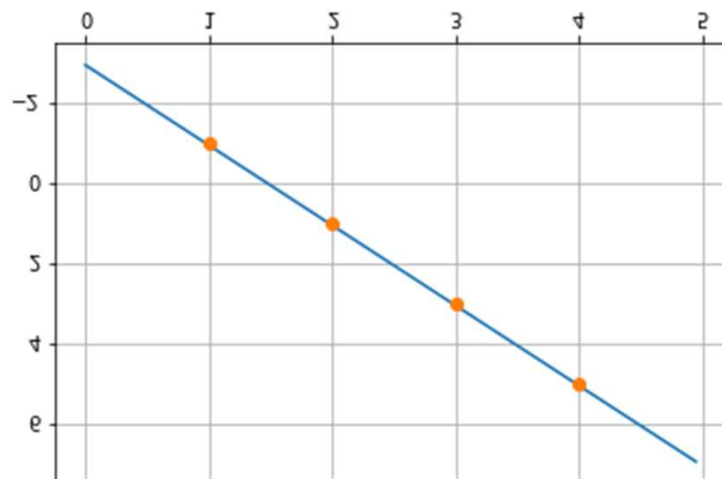


Example

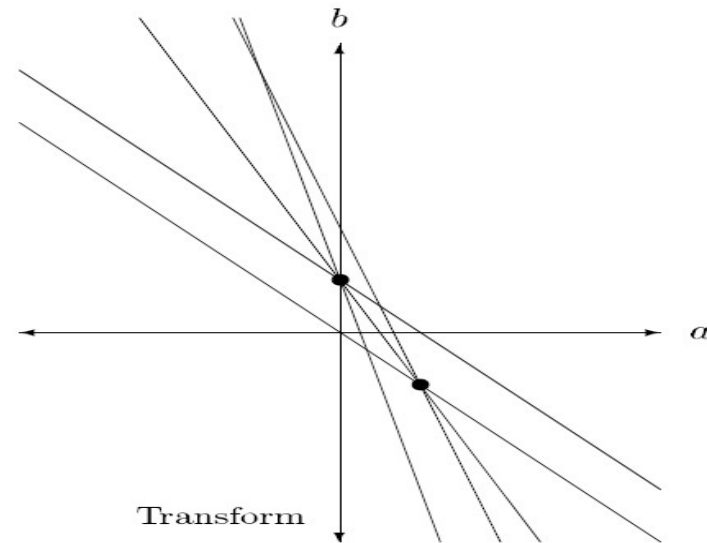
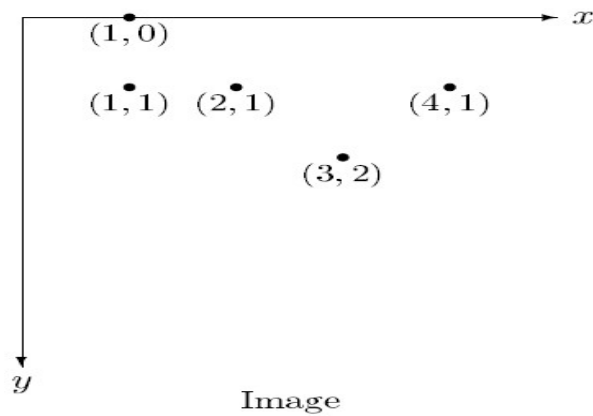
$$y=a*x+b$$

$$y=2*x-3$$

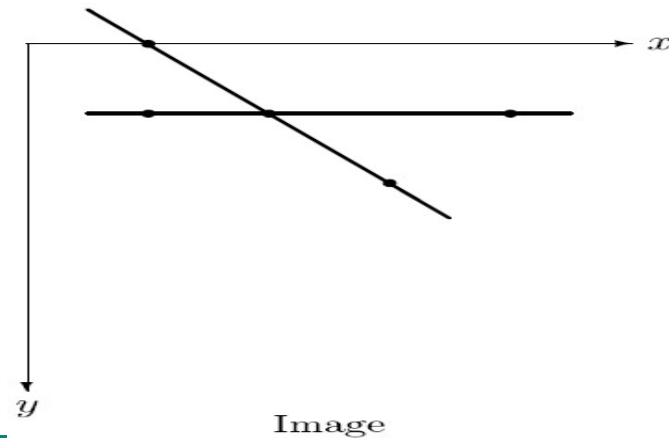
x	y	
1	-1	$-1=a*1+b$
2	1	$1=a*2+b$
3	3	$3=a*3+b$
4	5	$5=a*4+b$



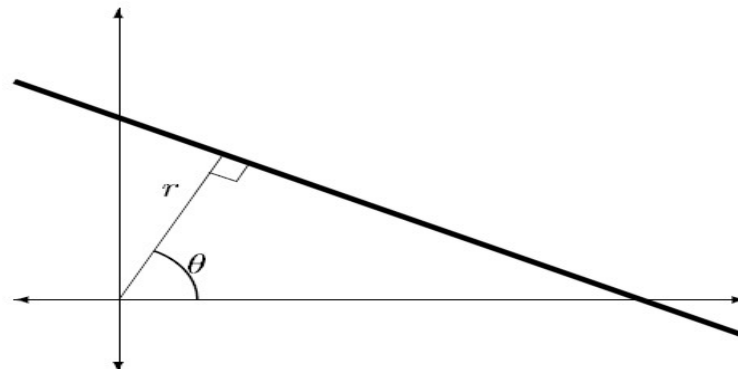
The Hough transform



$$\begin{aligned}(1,0) &\rightarrow b = -a \\(1,1) &\rightarrow b = -a + 1 \\(2,1) &\rightarrow b = -2a + 1 \\(4,1) &\rightarrow b = -4a + 1 \\(3,2) &\rightarrow b = -3a + 2.\end{aligned}$$



The Hough transform

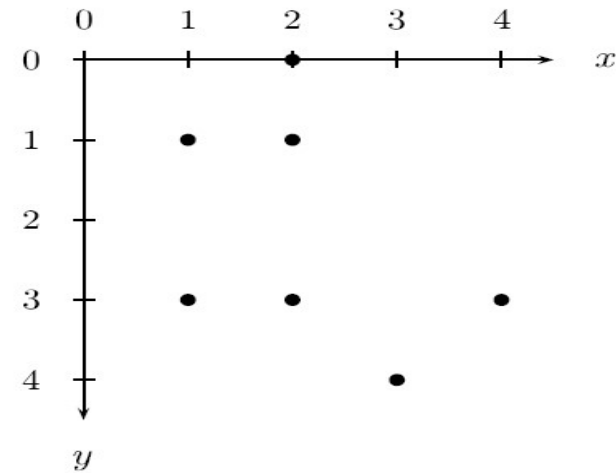


$$\begin{aligned} \frac{\text{rise}}{\text{run}} &= \frac{y - q}{x - p} \\ &= \frac{y - r \sin \theta}{x - r \cos \theta} \quad -\frac{1}{\tan \theta} = -\frac{\cos \theta}{\sin \theta} \end{aligned}$$

$$\frac{y - r \sin \theta}{x - r \cos \theta} = -\frac{\cos \theta}{\sin \theta}$$

$$y \sin \theta - r \sin^2 \theta = -x \cos \theta + r \cos^2 \theta$$

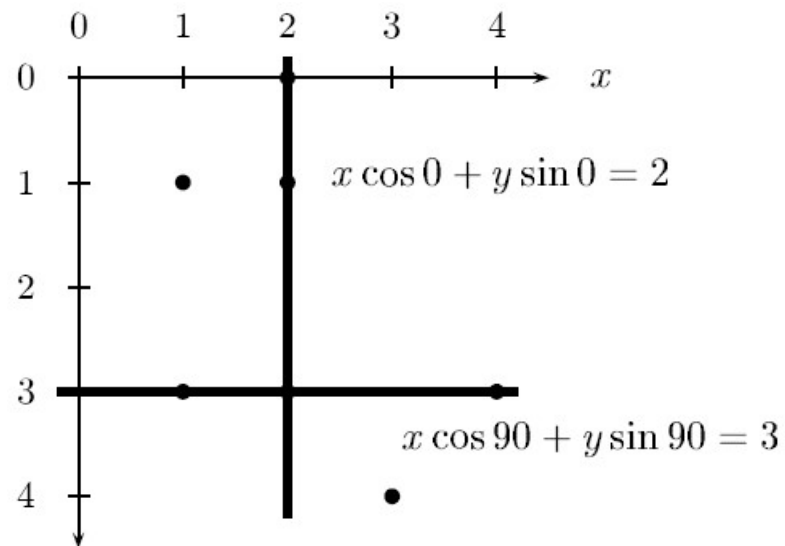
$$\begin{aligned} y \sin \theta + x \cos \theta &= r \sin^2 \theta + r \cos^2 \theta \\ &= r(\sin^2 \theta + \cos^2 \theta) \\ &= r. \end{aligned}$$



(x, y)	-45°	0°	45°	90°
(2, 0)	1.4	2	1.4	0
(1, 1)	0	1	1.4	1
(2, 1)	0.7	2	2.1	1
(1, 3)	-1.4	1	2.8	3
(2, 3)	-0.7	2	3.5	3
(4, 3)	0.7	4	4.9	3
(3, 4)	-0.7	3	4.9	4

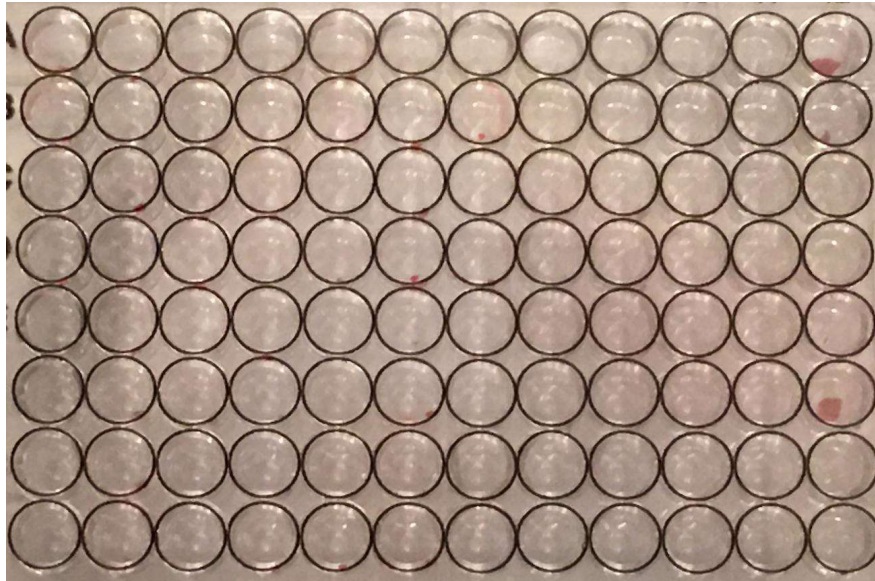
The Hough transform

	-1.4	-0.7	0	0.7	1	1.4	2	2.1	2.8	3	3.5	4	4.9
-45°	1	2	1	2		1							
0°					2		3			1		1	
45°						2		1	1		1		2
90°			1		2					3		2	

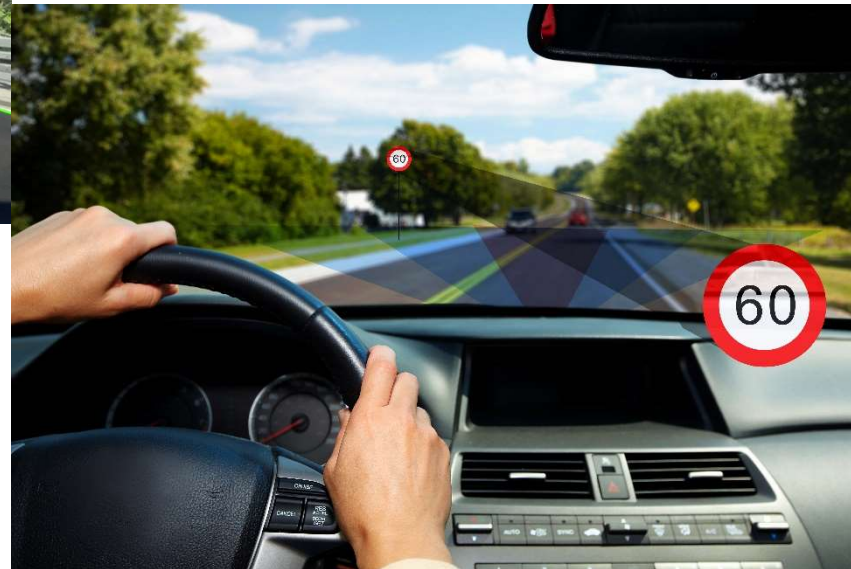


The Hough transform

- Circle



The Hough transform



<https://fnsautoglass.com/traffic-sign-recognition/>

<https://www.pathpartnertech.com/understanding-traffic-sign-recognition-system-used-in-adas-advance-driver-assistance-system/>

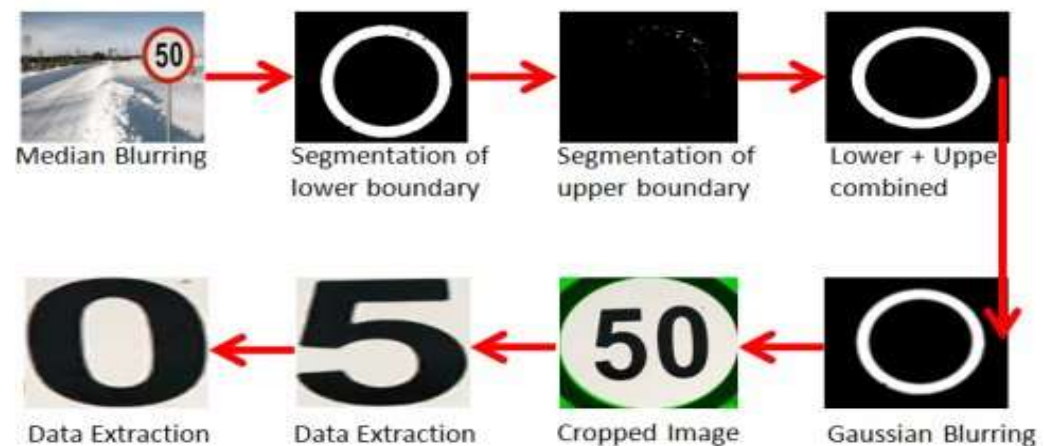


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The Hough transform

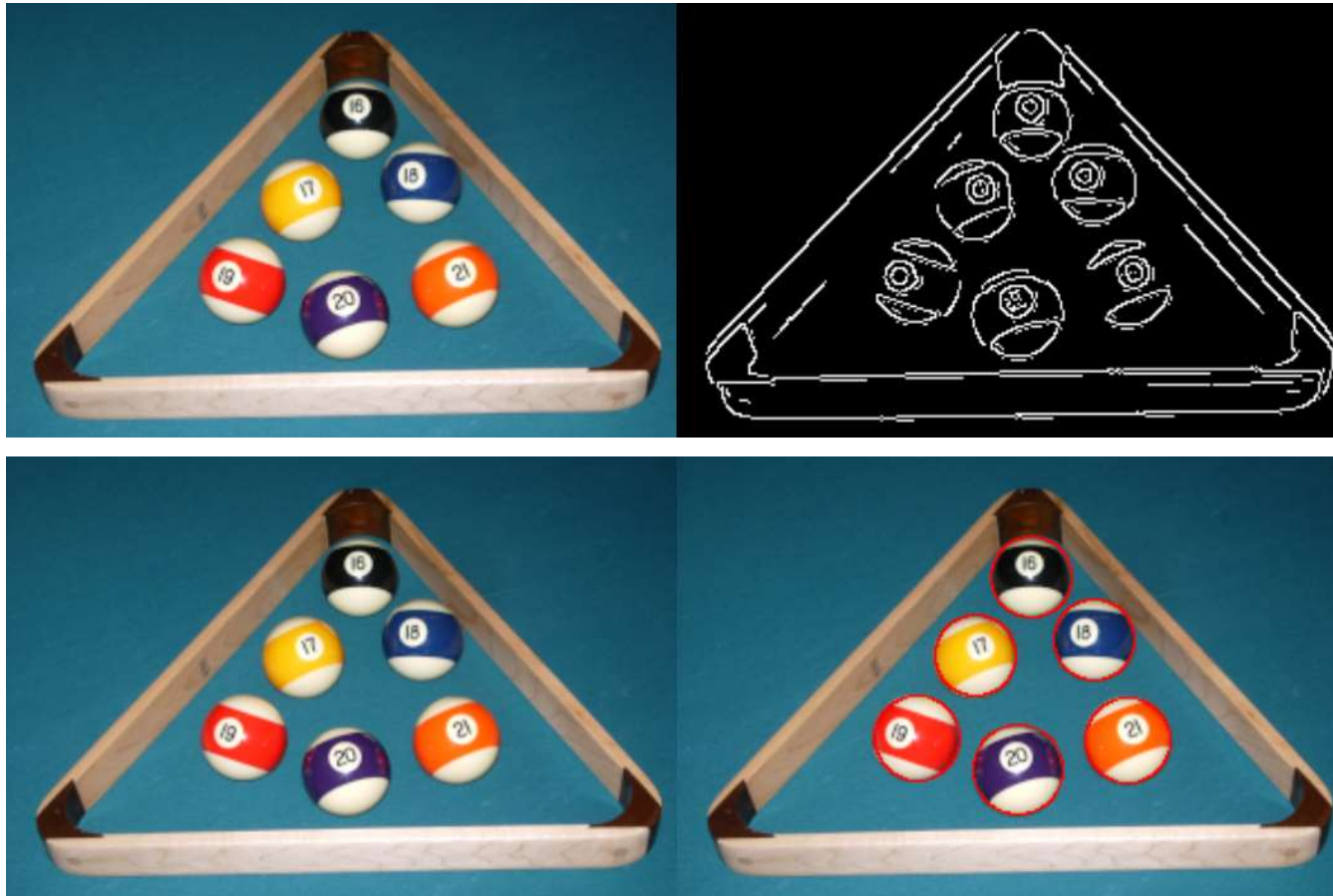
- Detection
 - Blurring
 - Colour-based detection
 - Shape-based detection
 - Cropped and Extract features
 - Separation
- Recognition
 - Tesseract
 - SVM



<https://www.design-reuse.com/articles/41154/traffic-sign-recognition-tsr-system.html>



Circle Detection



<https://www.codingame.com/playgrounds/38470/how-to-detect-circles-in-images>

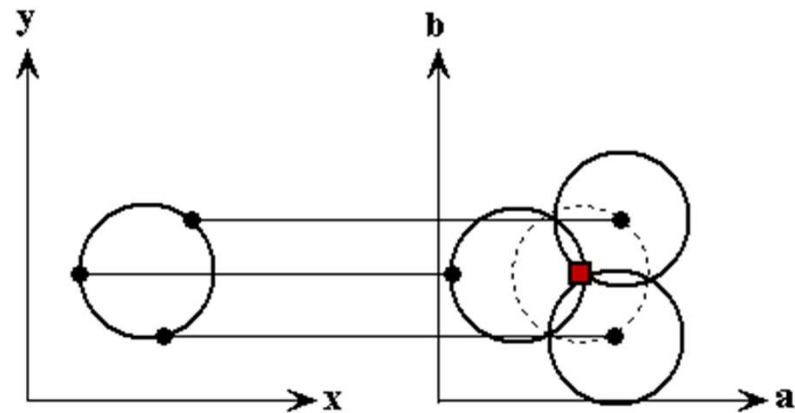
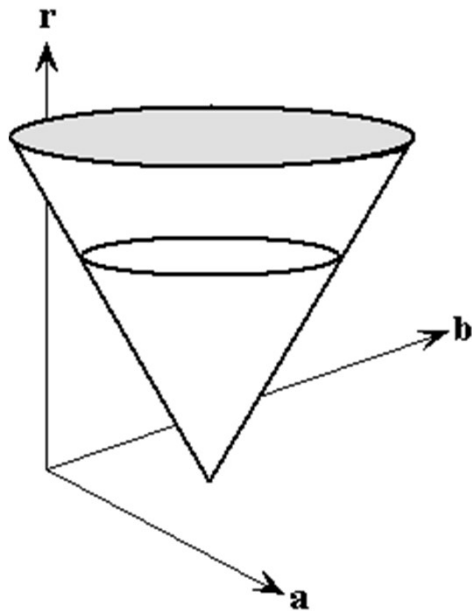


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Circle Detection

$$(x - a)^2 + (y - b)^2 = r^2 \quad (1)$$



Electric Fence

- <https://www.youtube.com/watch?v=AiW1QwiUFpc>
- https://youtu.be/-OKa_QHDjko

