Image Matching

Image Matching

Image matching is a process in which it is necessary to obtain the location of an object or sub-image in a reference image.

The process of matching should be invariant to large degrees of affine transformation of the objects, as well as noise present in the input signal.

Image matching can be generalized under two categories:

- **Feature level matching**
- **Gray level matching**

In the first case objects are stored as models in a database. Models are formed by a set of features invariant to affine transforms and noise. Typically features used are:

Moments, Corners, boundary descriptors, Hough transform, etc.

This false under the category of "*Pattern Recognition*"

In case of gray-level matching, we have two input images:

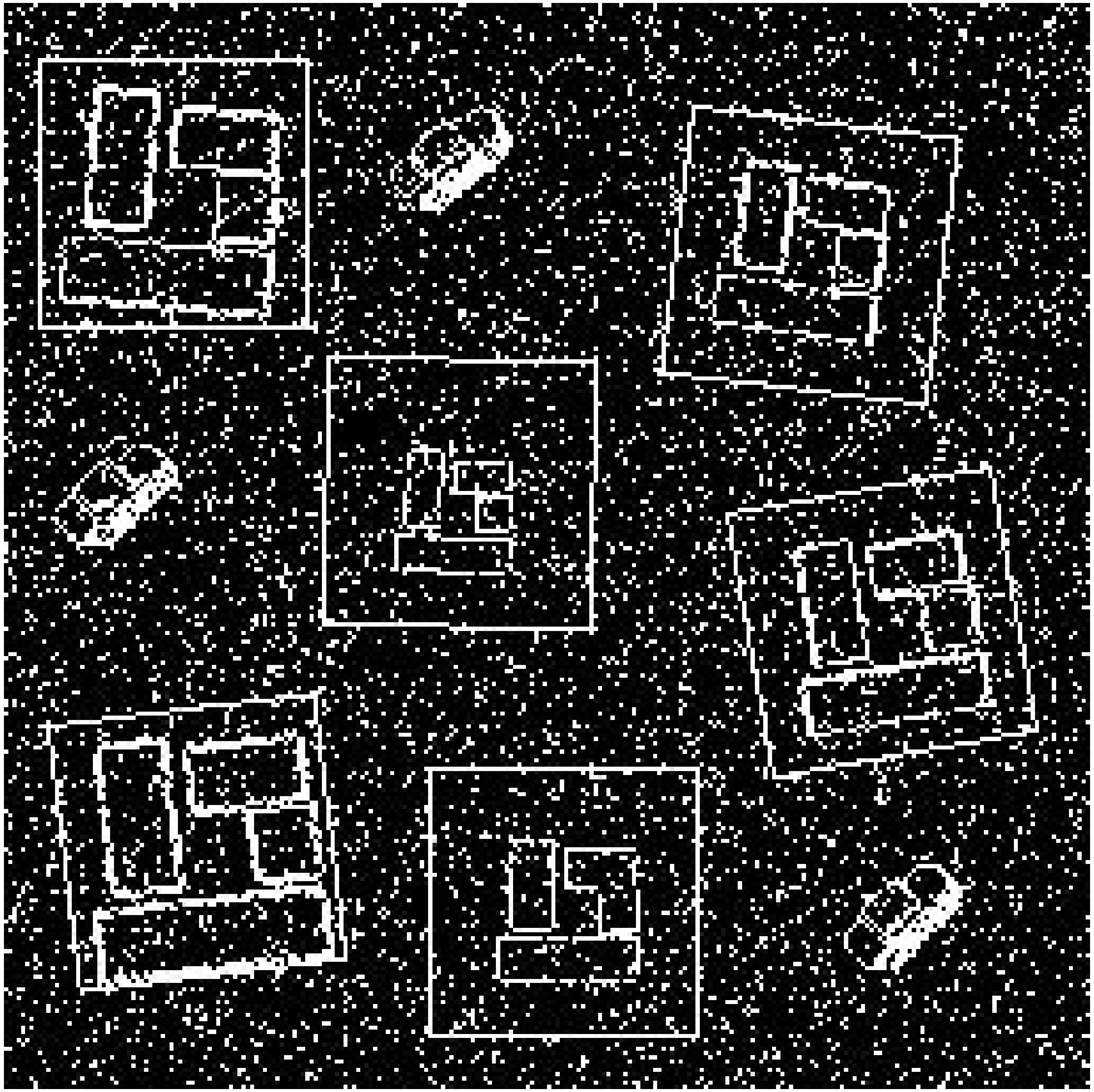
reference scene (f) and template image (g).

Use convolution theorem to compute the convolution of both these images. In one or both of these images, f & g, the pixel value at (x,y) may be replaced by a feature value. The problem is often referred as template matching.

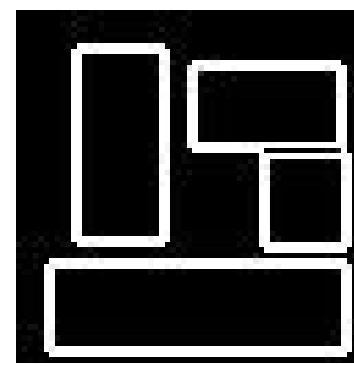
Template matching technique must be invariant to:

- **Rotation Translation and scale (RTS)**
- **Shear (to a limited extent, in general)**
- **Noise present in the image**
- **Sensor used to capture the image**

Still a research issue - problems get complicated when all of these factors occur simultaneously in the images.



Reference Scene with the location of the template identified by a rectangular box



Template

Correlation based approaches

Simple Correlation:

$$C(x, y) = m * f(x, y) = \sum_i \sum_j f(x - i, y - j)m(i, j)$$

- **sensitive to amplitude changes**
- **sensitive to scale, noise**

Correlation Coefficient

$$C(x, y) = \frac{\sum_i \sum_j [f(i, j) - \tilde{m}(i, j)][m(i - x, j - y) - \tilde{m}]}{\sqrt{\sum_i \sum_j [f(i, j) - \tilde{f}(i, j)]^2 [m(i - x, j - y) - \tilde{m}]^2}}$$

- **can overcome amplitude changes**
- **normalization for rotation and scale is difficult**

$\tilde{f}$: Average value of pixels in the reference image

$\tilde{m}$: Average of f(x,y) in the region coincident with the current location of m