for n anchor points, where p is the miss detection rate for a single anchor point.

While this invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, the preferred embodiments of the invention as set forth herein are intended to be illustrative, not limiting. Various changes may be made without departing from the spirit and scope of the invention as defined in the following claims.

For example, if the currency to be detected are limited to a relatively small set, for example, U.S. dollars only, more sophisticated anchor points such as corner points can be used to increase the efficiency of the process. Other variations include different template matching techniques, different edge orientation estimation methods, and different schemes for combination of anchor points. Such variations may effect reliability, complexity, speed, and the constraints on the patterns to be detected.

What is claimed is:

1. An anti-counterfeit detector for detecting whether an image to be photocopied is a currency note, the detector comprising:

storage means for storing a plurality of templates, each of said plurality of templates comprising at least one predetermined anchor point;

examining means for examining a portion of said image to be photocopied and for determining whether said portion contains a predetermined pixel intensity arrangement, wherein said predetermined pixel intensity arrangement is an edge and said examining means comprises means for calculating edge strength within said portion in accordance with the following equations:

$$f(x,y)=|d_V|^3(x,y)+|d_H|^3(x,y)$$

and

$$W=\Sigma f(x,y)$$

where d_V and d_H are differences in intensity of neighboring pixels in vertical and horizontal directions respectively, W is edge strength and summation is over said portion;

orientation determining means for determining an orientation of said predetermined pixel intensity arrangement;

positioning means for positioning said plurality of templates in alignment with said predetermined pixel intensity arrangement in accordance with said orientation determined by said orientation determining means;

matching means for comparing said plurality of templates to said predetermined pixel intensity arrangement.

2. An anti-counterfeit detector according to claim **1**, wherein if said edge strength does not exceed a predetermined threshold, said portion is discarded.

3. An anti-counterfeit detector according to claim **1**, wherein said orientation determining means comprises means for determining edge orientation ϕ in accordance with the following equations:

$$x_0=\{\Sigma f(x,y)x\}/W$$

and

$$y_0=\{\Sigma f(x,y)y\}/W$$

wherein x and y are the coordinates of each of said pixel intensity arrangement,

$f(x,y)=|d_V|^3(x,y)+|d_H|^3(x,y)$, where d_V and d_H are differences in intensity of neighboring pixels of said pixel intensity arrangement, $W=\Sigma f(x,y)$ over said pixel intensity arrangement, and

$$\phi=\theta+0.5\pi, \text{ if } \epsilon\geqq 0.5$$

and

$$\phi=\theta \text{ if } \epsilon<0.5$$

where

$$\theta=0.5\tan^{-1}(2M_{xy}/M_xM_y)$$

$$\epsilon=(M_x\sin^2\theta+M_y\cos^2\theta+2M_{xy}\sin\theta\cos\theta)/(M_x+M_y)$$

where M_x, M_y and M_{xy} refer to second order moments defined as

$$M_x=\Sigma f(x,y)(x-x_0)^2$$

$$M_y=\Sigma f(x,y)(y-y_0)^2$$

and

$$M_{xy}=\Sigma f(x,y)(x-x_0)(y-y_0)^2$$

and summation is over a circular area preselected diameter center at (x_0,y_0).

4. An anti-counterfeit detector according to claim **3**, wherein said preselected diameter is 8 pixels.

5. An anti-counterfeit detector according to claim **4**, wherein said positioning means comprises means for rotating said template according to the following equation:

$$x'=x\cos\phi+y\sin\phi$$

and

$$y'=-x\sin\phi+y\cos\phi$$

where (x,y) and (x',y') are coordinates of a pixel before and after rotation respectively.

6. An anti-counterfeit detector according to claim **1**, wherein said matching means further comprises means for determining matching strength r in accordance with the following equation:

$$r=\frac{\Sigma v(x,y)t(x,y)}{\sqrt{\Sigma v^2(x,y)}\sqrt{\Sigma t^2(x,y)}}$$

where v(x,y) and t(x,y) are intensity values at (x,y) in the image and each of the plurality of templates, respectively, and summation is over a template size.

7. An anti-counterfeit detector according to claim **6**, wherein a match is indicated by r being greater than a preset threshold.

8. An anti-counterfeit method for detecting whether an image to be photocopied is a currency note, the method comprising the steps of:

storing a plurality of templates, each of said plurality of templates comprising at least one predetermined anchor point;

examining a portion of said image to be photocopied and determining whether said portion contains a predetermined pixel intensity arrangement, wherein said predetermined pixel intensity arrangement comprises an edge and the step of examining comprises determining edge strength within said portion accordance with the following equations: