

CLAIMS

1- A method for detecting outlines for iris comparison, characterized in that it comprises:

- 5 | - a step of selecting (301, 401, 402) N best candidate outlines of circular form (403, 404, 405, 406) by applying a circle search technique to an image of edges of an iris (300),
- 10 | - a step of optimizing (302, 504, 505, 506, 507) the form and the position of the N candidate outlines, the optimized candidate outlines being determined by using parametric models, a set of parameters being determined for each candidate outline by minimizing a quantity of energy $E(C)$,
- 15 | - a step of selecting (303, 604) the best optimized candidate outline (605).

2- The method for detecting outlines as claimed in claim 1, in which the circle search technique used to select (301) the N best candidate outlines of circular form is a circular Hough transform (401).

20 3- The method for detecting outlines as claimed in claim 1, in which the circle search technique used to select the N best candidate outlines of circular form (301) is the RANSAC method.

4- The method for detecting outlines as claimed in any one of the preceding claims, in which N is superior to one.

54- The method for detecting outlines as claimed in any one of the preceding claims, in which the quantity of energy $E(C)$ is minimized by using the gradient descent method.

65- The method for detecting outlines as claimed in any one of the preceding claims, in which the quantity of energy $E(C)$ associated with a candidate outline C is equal to the sum of the edge energy $E_{edge}(C)$ and of the region energy $E_{region}(C)$ of said outline.

76- The method for detecting outlines as claimed in claim 56, in which the energy of edges is determined by using the following expression:

$$E_{edge}(C) = \int_0^{2\pi} \vec{\nabla} [I(\vec{X}_p(\theta))] \cdot \vec{n}_\theta d\theta$$

in which:

$\vec{n}_\theta$ represents the normal unitary vector outgoing at the angular parameter point θ ;

$\vec{\nabla} []$ represents the gradient function;

$\vec{X}_p(\theta)$ represents a column vector whose elements are the coordinates $x(\theta), y(\theta)$ of a point of the image;

$I(\vec{X}_p(\theta))$ represents the intensity of the image at the point associated with the vector $\vec{X}_p(\theta)$.

87- The method for detecting outlines as claimed in one of claims 65 or 67, in
 5 which the region energy $E_{region}(C)$ is determined by using the following expression:

$$E_{region}(C) = - \int_{Rin} \log P_{in}(I(X)) dX - \int_{Rout} \log P_{out}(I(X)) dX$$

10 in which:

Rin represents the region of the digital image of the eye inside the outline;

$Rout$ represents the region of the digital image of the eye outside the outline;

15 $P_{in}()$ and $P_{out}()$ correspond to the probabilities for a pixel of intensity $I(X)$ of the image to be located inside or outside the outline.

98- The method for detecting outlines as claimed in claim 67, in which the parametric model is a circle model, the set of parameters associated with this
 20 parametric model then comprising 3 parameters.

| 109- The method for detecting outlines as claimed in claim 67, in which the parametric model is an ellipse model, the set of parameters associated with this parametric model then comprising 5 parameters.

5 | 1140- The method for detecting outlines as claimed in any one of the preceding claims, in which the best outline (604) out of the N optimized candidate outlines (600, 601, 602, 603) is the one for which the energy $E(C)$ has the lowest value.

10 | 1244- A method for detecting inside and outside outlines of the iris of an eye, characterized in that the method as claimed in any one of the preceding claims is applied a first time to detect the inside outline and a second time to detect the outside outline.