System for Devices mobile based in recognition facial

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Abstract— In this paper is documents the development of the work of a security system for mobile devices based on Facial recognition. This recognition is based on the algorithm of Wu and SUSAN, it was obtained for 80% efficiency and was implemented in iOS platform. The cell phone is used for a host of activities is therefore necessary maintain secure information. One of the ways is through the recognition and fingerprint biometric facial features, etc. We propose not only the recognition of patterns biometrics; also added recognition of basic emotional states. Thereby providing a new form security for access to cell is achieved.

Keywords- Mobile, platform, iOS security, Wu, SUSAN

I. Introduction

Today, the demand for mobile telephony has grown, since their duties have increased, is not only a device that can make calls or send messages, they has become an important repository of information for the user.

Such a drastic and rapid change in the world of mobile technology has caused a twist to the work of each individual and personal lifestyle, since access to information has become indispensable in any time and place. In the same way also conforms an edge more than companies; it need to maintain competitiveness in the world.

However because of the new innovations in mobile devices, highlights the delicate security situation. Today lose hardware can pass to a second term in comparison with the loss of the information that is stored in it. Considering this problem, arises the need to protect the data on those devices.

II. Justification

With the introduction of smartphones to the market users found on the Internet a means of access to information in real time, where activities are conducted such as the sent and reception of mail, bank transactions, access to social networks and instant messaging, and it is precisely for this reason that today not only keep personal information, but also public, private and foreign, this makes that safety is an important factor for the users.

The proposed study has how aims to provide an alternative to security devices. Security methods such as passwords, each day are more complex in their development and administration, since, given the frequency with which are used in the workplace, it has become necessary to change constantly.

Facial recognition is an alternative that allows you to identify users recognizing traits and features of the face, with different States of mind.

Therefore, the facial recognition characteristics can meet that goal, since one need not memorize long strings, patterns or codes if not the same user is the key to gain access.

Taking into account that the faces are considered not dynamic, and rigid objects that have diversity as, shape, color and texture due to multiple factors such as the pose of the head, lighting, facial expressions, it seeks to take an effective methodology that exist to give you a refinement and optimization to implement it by way of developing a facial recognition system that satisfactory results under well-defined conditions.

Face detection is the first step to facial recognition system, it is concluded that one of the characteristics that are interested in the development of the project is the camera since it is the link to carry out other processes. To make a comparison detailed among popular smartphones today in day was decided to use the iPhone since it meets the physical characteristics required for this work.

III. ARCHITECTURE OF THE SYSTEM

The following block diagram, we show the distribution which will take system, the elements of which will consist of and the same functions.

It is divided into two modules, the first is responsible of the registration of users, in which patterns are only stored with their respective characteristics. The second will review and compare these files for subsequent awards. See figure 1 and 2.

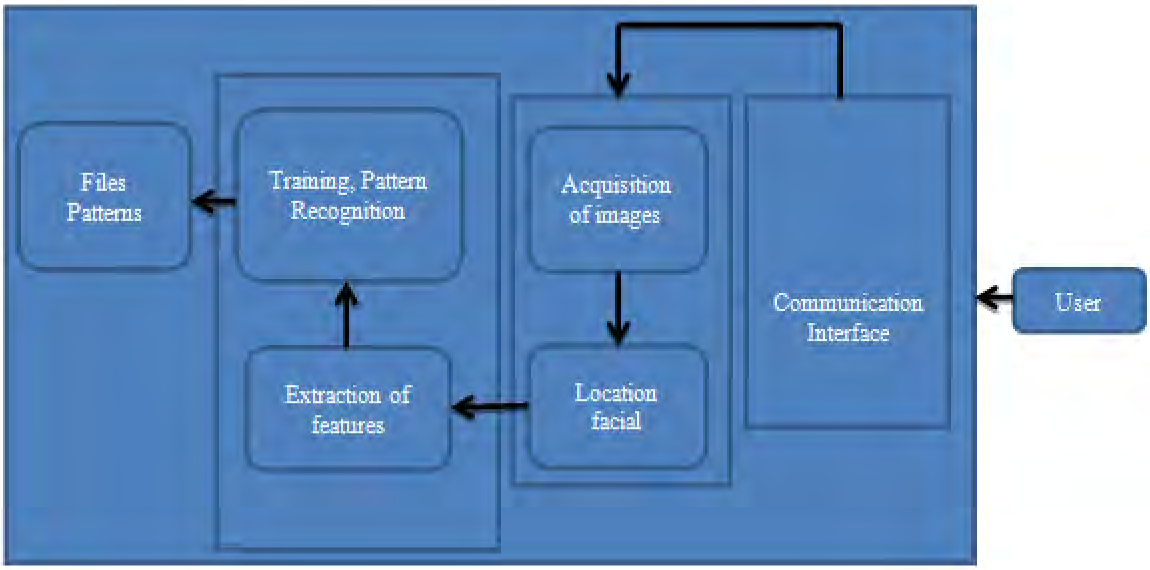

Figure 1. Registration module

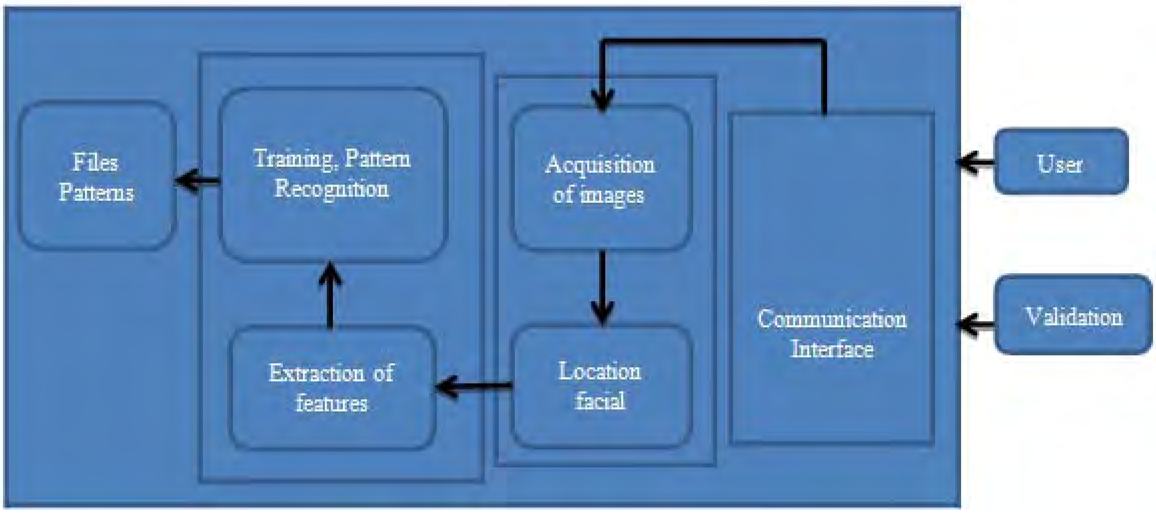

Figure 2. Authentication module

IV. MOBILE DEVICE

The device that will be used is the iPhone 4S because that processor Dual-core A5 provides two times more power and its graphics are seven times faster. The iPhone 4S is quick and sensitive, which makes the difference at the time of launch the applications.

The system has a camera with 8-megapixel with autofocus, tap to focus, LED flash, face detection and sensor lighting. [1]

These two characteristics are important for the development of the project due to image processing that take place. [2]

V. LOCATION OF THE FACE

For the location of the face is proposed to use a facial recognition API integrated in the Core Image framework. [3].This framework is Apple and is located in iOS 5.

It is worth mentioning that such API works locating the eyes and mouth.

VI. EXTRACTION OF CHARACTERISTICS

- Wu algorithm [4]

For each input region, assessed in the detector of facial features, which returns the coordinates of the location of the centroids of both eyes and mouth, as well as the rectangle surrounding the region of existence of the facial features.

Is detected the location of the nose as the midpoint between both eyes, and the midpoint between the height of the eyes and the height of the mouth.

- For each of the eyes

We are Removed a sub picture with a width of 30% of the width of the region of existence of facial features, and a high of 20% in the same region.

Sub picture is introduced into the detector of corner of SUSAN with a threshold “t” of 8, and g of 49/4.

A weighted average of the corners candidates is enhanced, giving greater weight to those that are in the area of probable occurrence of facial feature.

- For the mouth

We removed a sub picture with a width of 40% of the width of the region of existence of facial features, and a high of 20% in the same region.

The sub picture is introduced into the detector of corners of SUSAN with a threshold “t” of 5, and a g 49/4 of threshold.

- For the nose

We removed a sub image width distance between the centroids of both eyes, and a high of the distance from the centroid of each eye and the corner of the mouth corresponding to their own side.

The sub picture is introduced in the detector corners of SUSAN with threshold “t” of 5, and a “g” 49/3 of threshold.

- SUSAN algorithm [5] [6]

The principle of this algorithm is that each point of the image is associated with a local area with similar brightness.

The operator Susan is a new approach that is guided by the premise to obtain a system that extract features of the image (edges, corners, unions) in the shortest possible time. The main element of Susan is a nonlinear filter to detect features. This filter calculates the area (area Susan) of the image (within the domain defined by the filter), which has the same level of gray that the center. If, for example, we use a circular domain as a filter and work on an image discretized the filter accumulates the number of dots inside the circle with a level of gray similar to the center. In the Figure 3 can be looked what is the result of applying the filter to the whole image. The values shown within the circle indicates the value that provides the filter which is based on the detection of the corner points. In Figure 3 on the right side represents the result of calculating the area Susan to the top left corner of the rectangle (the figure is reversed). We can be observed that the image edges and corners show floor premises will be those who want to be drawn as a feature or another.

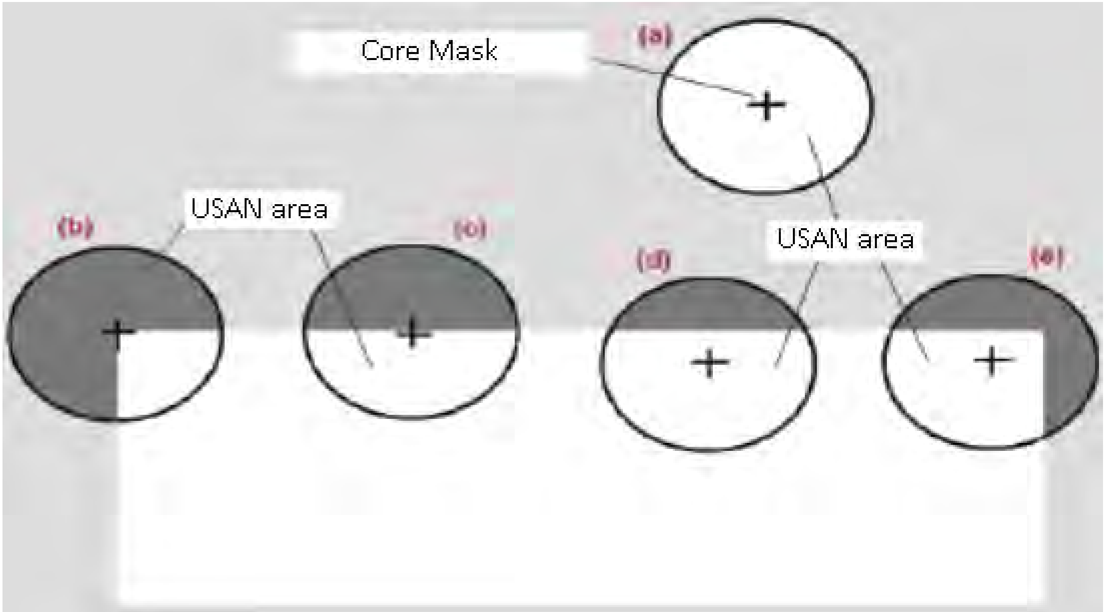

Figure 3. Mask in different positions [5].

The first step of calculating the area SUSAN is the same both for detecting edges and corners for points. This step is to calculate SUSAN area, which is determined at each point $X_0 = (x_0\,, y_0)$ of the image as in equation 1 y 2:

$$n(x) = \sum_{x \epsilon D} C(x, x_0) \tag{1}$$

$$C(x, x_0) = \begin{cases} 1 & si\ |I(x,y) - I(x_0, y_0)| \leq t \\ 0 & In\ other\ Case \end{cases} \tag{2}$$

Where D is the domain of the circle, I(x, y) is the brightness of the image at point x = (x, y) and t is the threshold that indicates the contrast of brightness allowed. If t is zero, we are taking into account only those points with the same level of gray that the Centre. Increasing t increase the contrast tolerated, which allows points absorb noise. This greatly affects the number of points corners detected, because of reducing the value of t increase that number, to be more sensitive to noise.

The detector of corners calculates the area SUSAN of the image and compares it with a geometric threshold. However, as can be seen in Figure 1, a corner is worth Susan lower than the edges so this threshold is set at$\frac{n_{max}}{2}$. To eliminate false positives are performed the following steps:

1. It is estimated the Centre of gravity of the area for the candidate. The distance from the Centre of gravity to Centre of the area determine if we have a false positive if this distance is short, it will be a false positive.
2. To be a true corner all the points that lie in a straight line connecting the Centre of the area with the Centre of gravity, must be part of the area Susan.
3. Apply a suppression of local minimum, eliminating all around the minimum minor candidate, in a 5 × 5 neighbor lines. [7]

- Generation of characteristic vector

Characteristic vector elements will be relations between distances of the face, this will prevent that you have to deal with the problem of the distance between the camera and the user.

Once done, proceed to calculate the distances between the following points (See figure 4):

- D1 = distance between the eyes;
- D2 = distance the edges of the mouth;
- D3 = distance between the centroid of the left eye and the left edge of the mouth;
- D4 = distance between the centroid of the right eye and the right edge of the mouth.
- D5 = distance between the point halfway between the eyes and the centroid of the nose.

Then the ratios are calculated [8] (relative distances between points). These ratios will serve as the features of the vector of characteristics, which represented face at the time of the classification.

TABLE I. CHARACTERISTIC VECTOR

Ratios	Relationship
Ratio 1	R1/R2
Ratio 2	R1/R3
Ratio 3	R1/R4
Ratio 4	R1/R5
Ratio 5	R2/R3
Ratio 6	R2/R4
Ratio 7	R2/R5
Ratio 8	R3/R4
Ratio 9	R3/R5
Ratio 10	R4/R5

TABLE II. RELATIONSHIP

Relations	
R1	Separation between pupils
R2	Mouth width
R3	Distance left eye mouth
R4	Distance right eye mouth
R5	Nose height

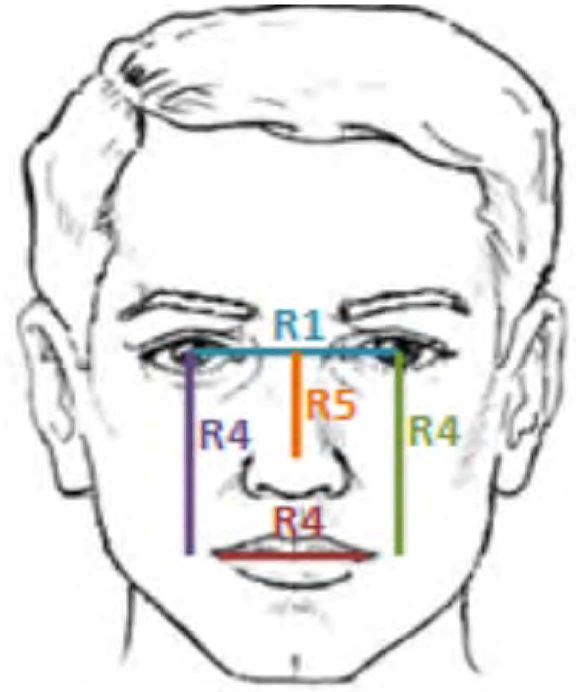

Figure 4. Relations located in the face.

VII. CLASSIFIER

To perform recognition, first it is necessary to train the classifier; it means to use a form of learning, allowing the system to learn the faces that form the set of training. After this will continue to the stage of recognition, which will be provide with images of faces, and thus know whether it is or not the faces found in the database. [9]

- Radial basis neural networks [10][11]

Neural network are multilayer with connection to the front and are characterized because they consist of a single hidden layer, and each neuron of this layer has a local character, i.e., each hidden neuron network engages in a region different from the space of input patterns. The local character is derived from the use of radial basis function of activation functions.

Radial basis neural networks approach complex relationships through a collection of local approximations of lower complexity, so that the problem is divided into different sub problems with less complexity.

The activation of a hidden neuron in a radial basis network depends on the distance of the input pattern X (n) to the Center C of the radial basis function. These basis functions have a local character since it is functions that can reach a level close to its tour when input pattern this close to the Centre of the neuron, so that if the pattern moves away from the Center, the value of the function is approaching the minimum value of the route.

The radial basis functions commonly used are:

- Gaussian function.
- Inverse quadratic function
- Multi quadratic inverse function

The network model of Radial basis that will have this work will have 10 input, ten neurons in the hidden layer and 1 output neurons, as shown in Figure 5. The Gaussian function used is compared to the inverse quadratic function and the inverse function multi quadratic, which provides a better separation between classes.

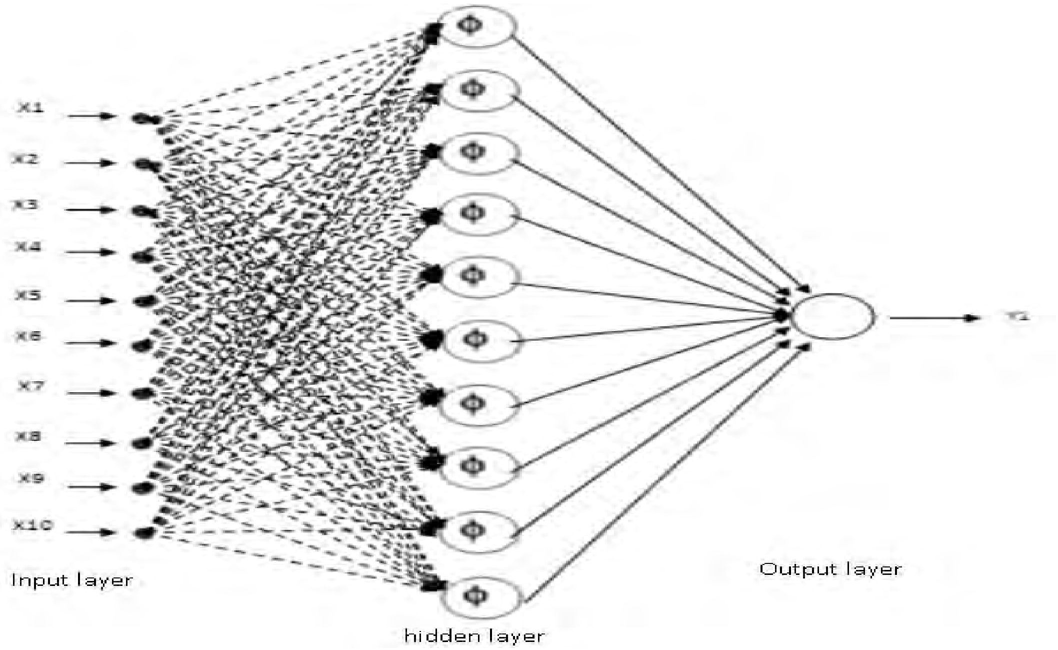

Figure 5. Radial basis network architecture

VIII. PERSISTENCE OF INFORMATION

To keep the main user data and data that are thrown by the classifier, which are necessary to carry out the process of comparison, text files are concerned. These files will be saved the serialized arrays, i.e. that the object will be written and when it is required to read the same object; it will be read without having to convert it to another format.

IX. INTERFACE

This screen is handled the basic settings for the correct functioning of the application. Likewise will have 4 tabs:

- The first will serve for the registration of the primary user.
- The second will be handled invited persons who may access.
- In the third, you will find the configuration of the system, i.e., is the place where will you activate or disable the application.
- And in the latter it will contain information from developers and help. (See figure 6 and 7)

Figure 6.Uuser registration: users

Figure 7. Adjustments

X. TEST

Tests of the system were carried out with serious gesture in different scenarios, which are listed below:

- Luz Natural: Front, side and back.
- Artificial light: front, side and back.
- Natural light in shadow: front.

TABLE III. SERIOUS FACE INFORMATION

	Armando		Vania		Adriana	
	False negative	False positive	False negative	False positive	False negative	False positive
Natural light front	0.6666667	0.1	0.6	0.33333	0.6	0.33333
Natural light from side	0.5333333	0.2	0.5333333	0.36667	0.533333	0.4
Artificial light from front	0.4666667	0.3	0.4666667	0.36667	0.733333	0.16667
Artificial light from side	0.6	0.3	0.4	0.4	0.666667	0.16667
Lamplight of back	0.9333333	0.06667	0.8666667	0.06667	1	0
Natural light from shadow	0.4	0.1	0.5333333	0.33333	0.4	0.23333

In general the results of all tests are shown in table 4.

TABLE IV. GENERAL INFORMATION

False positive	False negative
0.5111111	0.25079

XI. CONCLUSIONS

The presence of false negatives is related to various factors, such as the partial or total absence of the lighting on the face and with the angle of inclination.

We get no more than 50 seconds average training time, which includes 5 image capture, extraction of characteristics and training in the radial basis network. In the same way at the time of recognition takes, in the best case 5 seconds, i.e. recognized the person on the first picture; and in the worst cases it takes 25 seconds, i.e. taking the 5 photographs.

It was found that mainly the performance of a neural network in a device is adequate but is not the most optimal, since it does not provide the most accurate results.

As a general conclusion of the work, one can mention that the time that is done training and the approximation to the desired output is consistent. Similarly the time which is the process of recognition is competitive compared with other similar systems results.

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