Graphing emotional patterns by dilation of the iris in video sequences

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***Abstract*— For this paper, we took videos of iris of people while induced a feeling of joy or sadness, using videos to motivate the states affective. The manuscript implemented is a system of recognition affective pattern by dilating the iris, with which extracted images of the videos. The results obtained are plotted to facilitate the interpretation. A suitable treatment occurred for locating the pupil and the obtaining of the diameter of the pupil. The graphics are based on statistical time intervals.**

Within the research found that the iris diameter varies depending on your mood present in the subject of study. There is software that can detect changes in the pupil diameter, however it is also develops software, the main objective is to detect changes with respect to affective states and in this study is the main contribution. The joy and sadness were the emotional states that may differ. The system presents graphs that can be observed when analyzing the dependence between feelings and dilation present in the eye.

Keywords- Pupil dilation; joy; sadness; mathematical morphology; average interpolation.

I. Introduction

The emotion recognition is a step to truly intelligent machines, therefore is essential, for recognition the emotional pattern recognition to understand the human intelligence [1].

Based on the growing interest in using the technology to read emotions in a human (affective systems) [2] [3] [4] and the fact that they have found evidence that emotions cause changes in the iris [5], The system developed is a system to recognize and classify the patterns that occur in the iris of a person while changes your mood, focusing in two of the basic human emotions: joy and sadness. Although the reader should know that Paul Ekman bases their work on six basic emotions [6].

II. Methodology

The pupil is a hole that is images of black. In order to eliminate the illumination and brightness was used HSV color format [7][8], the brightness component is greater than 0.5, as it goes from 0 to 1; however it is worth taking a higher than average brightness. Located these points, it creates a new pixel with the same value H and S, but lower in V. MAX is the maximum value of the components (R, G, B), and MIN the minimum value, then we have that HSV by (1) (2) and (3) allow the conversion to this format [9].

$$H = \begin{cases} not\ defined, & if\ MAX = MIN \\ 60^o x\ \frac{G-B}{MAX-MIN} + 0^o, & if\ MAX = R \\ & y\ \ G \geq B \\ 60^o\ x\ \frac{G-B}{MAX-MIN} + 360^o, & if\ MAX = R \\ & y\ G\ \geq B \\ 60^o x\ \frac{G-B}{MAX-MIN} + 120^o, & if\ MAX = G \\ . & \\ 60^o\ x\ \frac{G-B}{MAX-MIN} + 240^o, & if\ MAX = B \end{cases} \qquad (1)$$

$$S = \begin{cases} 0, & if\ MAX = 0 \\ 1 - \frac{MIN}{MAX}, & in\ the\ other\ case \end{cases} \qquad (2)$$

$$V = MAX \qquad (3)$$

For the analysis of the eye, it is isolating the darkest elements of the image, which also are tabs and areas outside the pupil. However, these other areas are irregular, so it makes an analysis of distances of each pixel to background of the image, figure 1. All operations for isolate the iris is made in a binary image, where has a 1 if this point is considered possible pupil and 0 if not [10].

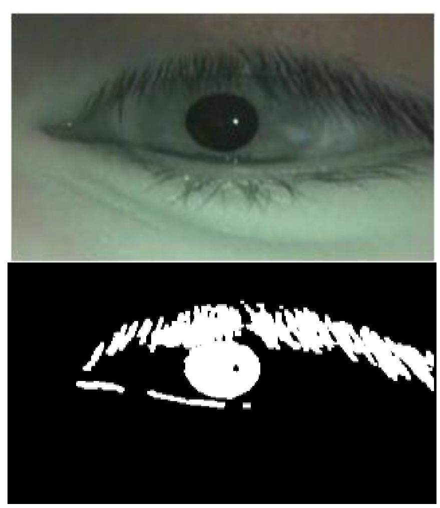

Fig. 1. Input Image and Image binarized.

The pixels with greater distance from the background are considered part of the pupil, determining the pupil area. See Figure 2.

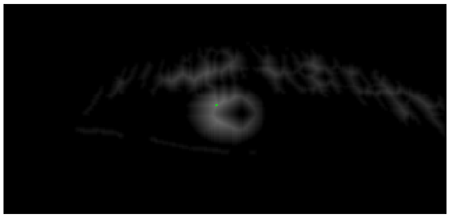

Fig. 2. Image of distances, the white represents the greatest distance from pixel to the bottom; the circle is the highest value.

By means of operations of morphology mathematical of opening are eliminated small elements (noise) (4)[5][11].

$$A \cdot B = (A \ominus B) \oplus B \qquad (4)$$

Once detected the pupil, algorithms are used to fill the pupil, through the closure operation (5) [5][12].

$$A \cdot B = (A \oplus B) \ominus B \qquad (5)$$

Once obtained and recorded the diameter of the pupil of each image from the video, the system allows see these results graphically as shown figures 3 to 11. In the y-axis are the mm by the pupil diameter, on the axis "X" are represents all the images from the video, it are get 20 pictures for each second of video.

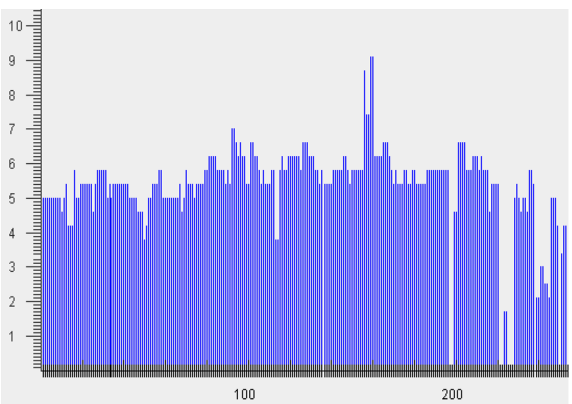

Fig. 3. Graphic bars

Fig. 4. Figure continues

In graph with bars and the continuous plot of figures 3 and 4 are shown the diameter of the pupil respectively found in each of the images [13].

In the figure 5, it was a combination of the graph with bars and graph continuous.

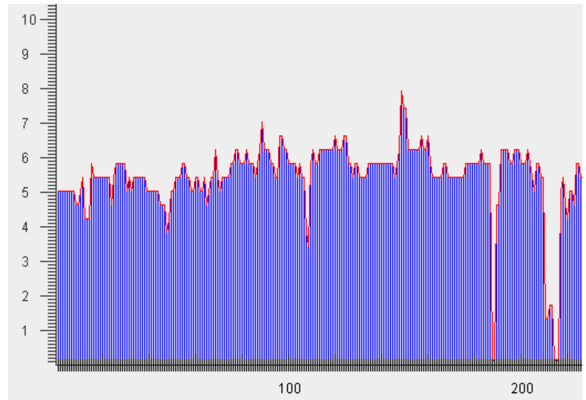

Fig. 5. Graph combination

In figure 6, red lines represent the average obtained after twenty images, that is to say, after each second video. In the graph of the Figure 7 can see how the diameter of the pupil changes in each second of video.

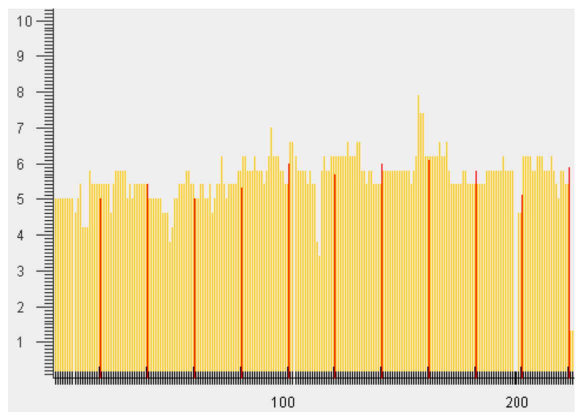

Fig. 6. Graph with average

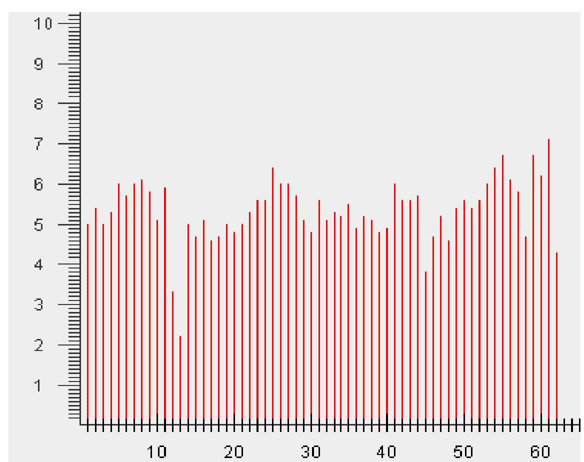

Fig. 7. Graph average.

In the graphs of figures 8 and 9, it is possible to recognize the results found after Interpol, blue bars and black line segments now represent the images that initially gave the zero.

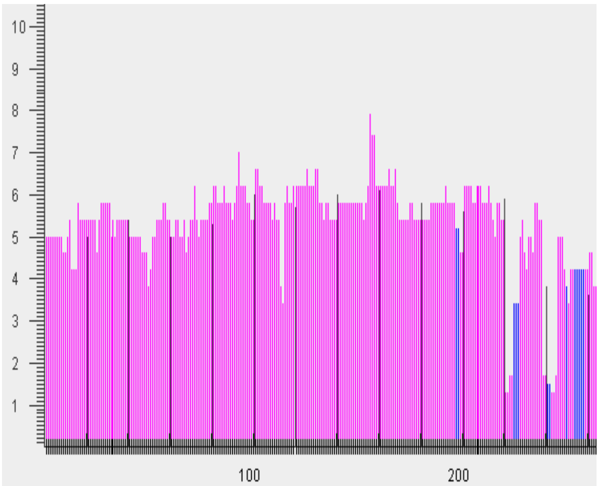

Fig. 8. Graph Interpolation bars

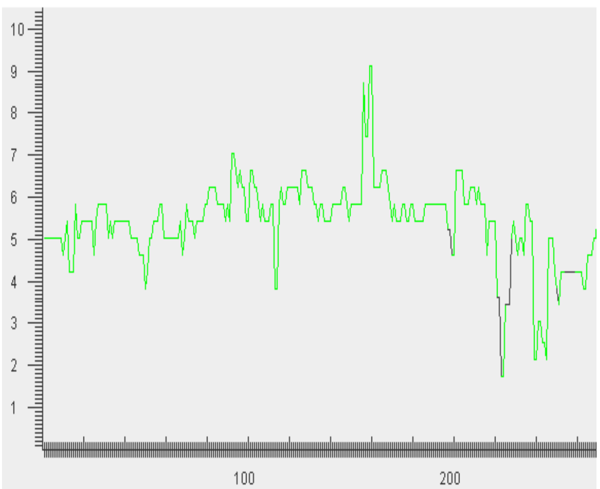

Fig. 9. Graph Continuous Interpolation

The graph in figure 10 gives the diameter obtained in each second of video, after the interpolation. In the graph of the Figure 11 is possible to show the image corresponds to the bar where is positioned and press the mouse computer.

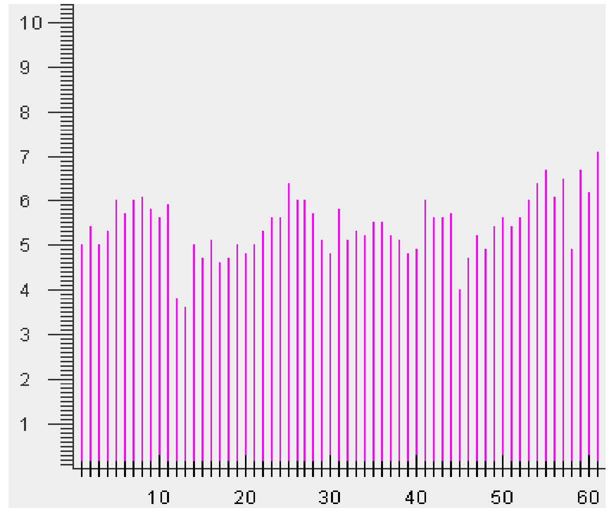

Fig. 10. Graph Average Interpolation

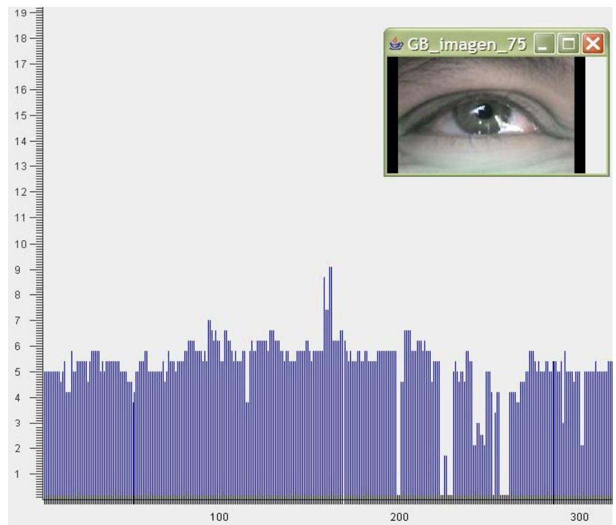

Fig. 11. Graphical analyzed image

III. Results

The following chart shows the average diameter of the pupil for each second of video of one of the subjects of test with predominant emotion "joy":

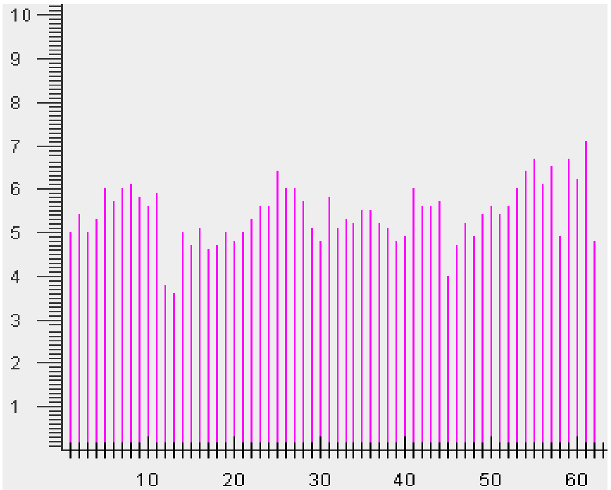

Fig. 12. Figure-1-subject-3

After analyzing the video that corresponds to the graph of figure 12, observe that when the subject makes laughter increases the amplitude.

Fig. 13. Images of heights.

Figure 13 contains images that correspond to the high points of the graph bars in figure 12. The graphs show interesting results when values of zero diameter. These images are usually where the person closed the eye or the pupil; the eye is in the edge, or simply an image that does not contain an eye, figure 14 shows some examples.

Figure 14 Images zero.

The software can detect the joy and sadness through graphs, however, is detectable (but it is very difficult) other emotional states, what requires more extensive analysis to determine the mixed affective states.

The analysis allows get median, variance, standard deviation and the range where we find most of the data [14].

IV. CONCLUSIONS

Working with emotions is not easy, the fact feel recorded or observed does not allow feelings flow easily, although this is able to detect changes in the iris of individuals, some researchers have even found not only changes in the eye with the affective state, also with the degree of cognition [15] [16], but has not determined a range of dilatation in relation to affective state. The feeling where became more evident the change was the joy. It is noticeable from the moment you take the video, when someone laughs the pupil diameter increases proportionately, but not directly, on a range of 5 to 7 mm, it is possible to say that there is a dependency statistics. In some cases difficulties were encountered because many people tend to close their eyes when laugh, blink or cry, but these are changes that also the system can detect.

After a number of tests to the same person are located data that indicates which mood is reflecting this in their eyes; if stored the data the system can indicate when the subject is sad or happy, following the same procedure for each person. It is possible to consider other types of emotions like anger, stress, fear, etc.

Once the system can indicate the state of mood of a subject, we will have to see, that so congruent it is the emotion of the person with who indicates software; which is complex, because the subject may lie in their emotional state. However is clear, the mood changes the diameter of the pupil, allowing differentiate the joy of sadness.

ACKNOWLEDGMENT

Thanks to The IPN (National Polytechnic Institute) who through of COFAA (Commission for promotion to the academic support) allows us to conduct the researches.

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