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Description of Objects in Images of an Internet Search Engine by Topological Attributes

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Abstract— ***One method for searching internet image objects is proposed; by digital processing using topological descriptors. The number of objects O, Euler number and the canters of gravity was used. Localization is achieved in real time by developing a database based on Mexican culture, in which the search is done by text, but by an image of the object to be found.***

Keywords— Digital image processing, search, descriptors, internet.

I. Introduction

Mexico is a country rich in customs, traditions, languages, culture, roots, etc. (Tejada Z et al, 2011). One of his great wealth is the diversity of craft objects in images found on the internet. The traditional search is performed via text in the internet (Alejandro P, 2005); which is a problem if we do not know the name of the object and only have a picture of it. This paper presents the way in which objects are located within an image of a website; this requires digital signal processing image (Pajares P et al, 2004).

Image search has diverse applications ranging from therapeutic purposes (Siri L et al,2000); through those that are designed to support disabled people based on their emotions (Fonseca D et al,2008);; and finally we cannot forget those with scientific or educational purposes (Aranda M.C et al, 2008).

Hence the importance of the research conducted; especially considering the cultural wealth of nations. Although, the project only focuses on basic objects and Mexican roots can be applied to any region in the world.

Visual descriptors representing visual features of images arranged in content (Manjunath B.S. et al, 2002). The description is automatically generated by digital image processing.

Form: It has so important semantic information that can only be extracted by segmentation similar to that performed by the human visual system (Marcos M, 2014).

Topological attributes are invariant properties of the deformations of objects (Garcia O, 2011). It is for this reason that we propose these techniques because it avoids taking into consideration the size and rotation of objects to look at the pictures. It also uses the Fourier transform.

II. Material and Methodology

The system has a key content manager, who also supplies the database so that the main features or image patterns are stored.

The query module applies the same algorithms as the administrator to generate the object description and comparing them with those stored in the database using the Mahalanobis distance (Escobedo M.T. et al, 2008) . The query module sends the results to the block "Result Set". See figure 1.

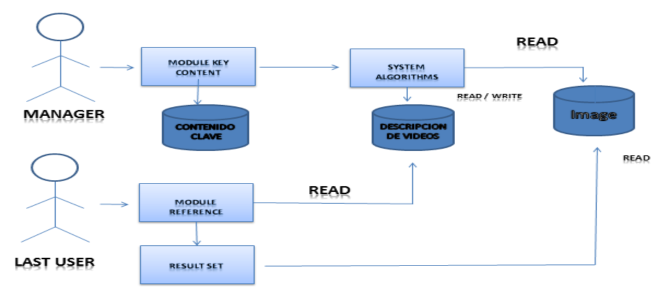

Figure 1. Block diagram system

2.1. Query Module.

It is the application that allows the user to view the images and choosing the item you want and the point where it is; in the contrary case, the message "Not Found ships is provided. The web page is shown in Figure 2.

Figure 2. In the portal.

The page can provide a brief description of the types of Mexican architecture and objects that can be located. See Figure 3.

Figure 3. Screen classification of Mexican architecture.

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For input image to find you have a page with restrictions. See Figure 4.

Figure 4. Screens capture the quest.

2.2. The Fourier transform

Named for Josheph Fourier, is used as part of the analysis of the frequencies embedded in a function. The Fourier transform of a continuous and integrable function of 2 variables defined with Eq. (1) (Sanchez J.M. , 2014):

$$F(u,v) = \iint_{-\infty}^{\infty} f(x,y)e^{-2\pi i(ux+vy)}dxdy \qquad (1)$$

and its inverse as Eq. (5):

$$f(x,y) = \iint_{-\infty}^{\infty} F(u,v)e^{2\pi i(ux+vy)}dxdy \qquad (5)$$

2.3 Isolation of objects in the image

To isolate the object to process steps are carried out:

1. May be done a edge detection or a binarization
2. Dilation is performed to add pixels on the borders of the image or erosion to remove pixels of the border. This allows bettering describing each object.
3. Connectivity or vicinity of the object in the image is determined.
4. . Account and label each of the objects in the image
5. In order to process is selected.

2.4. Moments

The moments are used to calculate geometrical characteristics of the image such as the area with the point (0,0) and the canters of gravity of the image. Are expressed by the general equation (2) (Pertusa J.F., 2010):

$$M_{p,q} = \sum_{-\infty}^{\infty}\sum_{-\infty}^{\infty} x^p\, y^q\, I(x,y) \qquad (2)$$

Where I (x, y) is the pixel value in question, "x" and "y" are the coordinates of the pixel.

2.5 Center of Gravity

Result from the early stages to be divided by the time (0.0), that is, the area A corresponds to the geometric center of the image are expressed by the equations (3) and (4):

$$\bar{X} = \frac{\sum_{X=1}^{N}\sum_{y=1}^{M} xI(x,y)}{A} \qquad (3)$$

$$\bar{y} = \frac{\sum_{x=1}^{N}\sum_{y=1}^{M} yI(x,y)}{A} \qquad (4)$$

2.6. Centered moments

They are invariant to the translation and moments are calculated from the center of the object. Are obtained with Eq. (5):

$$\mu_{p,q} = \sum_{x=1}^{N}\sum_{y=1}^{M} (x-\overline{x})^p\,(y-\overline{y})^q\, I(x,y) \qquad (5)$$

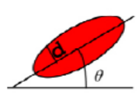
2.7 Compactness or compaction.

It is a relationship between the perimeter of the shape and the area thereof. It is invariant to scaling, translation and rotation. It is defined by Eq. (6) [5]:

$$\gamma = \frac{4\pi A}{P^2} \qquad (6)$$

2.8 Orientation

Is the angle between the major axis of an ellipse circumscribed image and abscissa. It can be expressed by means of invariant moments [5] in Eq. (7):



$$\theta = \frac{1}{2}\, tan^{-1}\left[\frac{2\,\mu_{1,1}}{\mu_{2,0} - \mu_{0,2}}\right] \qquad (7)$$

2.9 Eccentricity

It is a relationship between the major axis and the minor axis of the ellipse that circumscribes the image. Its expression is:

$$e = \sqrt{1 - \frac{b^2}{a^2}} \qquad (8)$$

Where b is the major axis and the minor axis.

III. Results and Tables

Different images with various objects were analyzed, such as a mouse, labeled mouse1.jpg to mouse4.jpg and corresponding to a mouse (animal), mouse5.jpg image. The size of the images was altered without changing its proportions, that all correspond with 800x1000 pixels.

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The processing consisted of transformation to grayscale, binarize 0.75 level, erosion and dilation to fill gaps and get the negative. This is shown in Figure 5.

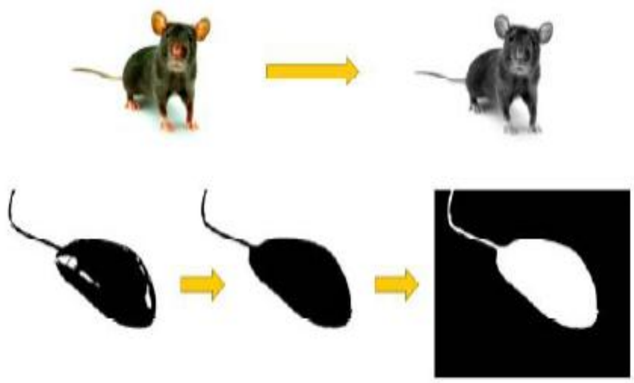


Figure. 5 Image processing.

Extracting image frequency performed with a 101 x 101 window values to the matrix center frequencies corresponding to the low frequencies of the image. See Figure 6 These extracts were compared using the correlation.

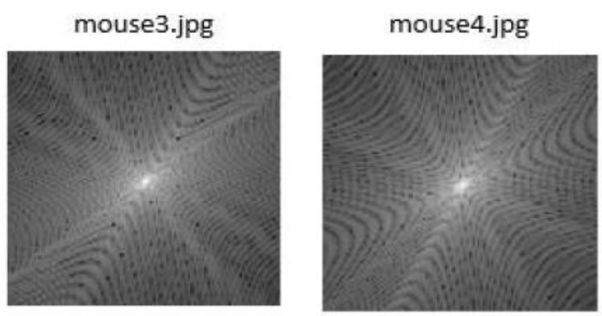


FIGURE 6 EXAMPLES OF FOURIER TRANSFORMS (2D)

Geometric descriptors were also used. This parameter was used:

1. Area
2. Eccentricity
3. Number of Euler
4. Orientation
5. Perimeter

Table 1. Correlation of frequency fourier descriptors.

Unit in pixeles (px)	Mouse1	Mouse2	Mouse3	Mouse4	Mouse5
Mouse1	1	0.613	0.631	0.622	0.585
Mouse2	0.613	1	0.604	0.615	0.562
Mouse3	0.631	0.604	1	0.635	0.554
Mouse4	0.622	0.615	0.635	1	0.523
Mouse5	0.586	0.529	0.554	0.523	1

Also, the results of the geometric analysis of the images are shown in Table 2.

Table 2. Values of geometric attributes.

Attribute	Mouse1 (px)	Mouse2 (px)	Mouse3 (px)	Mouse4 (px)	Mouse5 (px)
Area	140079	218726	461687	360739	180830
Perimeter	2428.09163	2566.67446	2845.16688	2598.62273	2854.93016
Eccentricity	0.89864834	0.84810504	0.82910645	0.83728881	0.57800951
Orientation	-29.6385772	-33.949581	-32.4436377	-45.1476451	44.908104
No. of Euler	1	1	1	1	0
Compactness	0.29857453	0.41722344	0.71670762	0.6712997	0.2789782

From these data can be proposed discrimination functions for which of these classes the image belongs, that is, if it is a photograph of a living organism or an electronic device.
The predominant characteristics of an electronic mouse could be described as:

Correlation at frequencies> 0.6
.8 <Eccentricity <.9
- 50 <Guidance <- 25
Euler number = 1
.29 <Compaction <.75

That is, if an object is out of this type is not correct to say that an electronic mouse, at least not similar to those analyzed in this practice. However, if an object is within the range obtained is only possible to say that the object resembles an electronic mouse so it probably is.
The same procedure is used for various objects. You can even apply some other features and compare parameter using Mahalanobis distances of the result. The figures 7 shows the processing for a pencil.

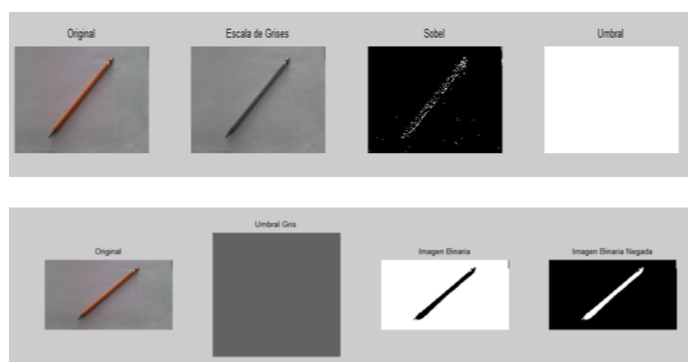


Figure 7. Processing for a pencil

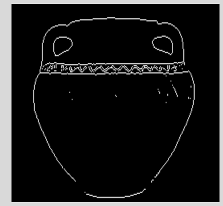
And the same for rubber and tweezers. The results are summarized in table 3.

Table 3. Processing for obtaining descriptors another objects.

Figure	Lapiz1 (px)	Lapiz2 (px)	Lapiz3 (px)	Goma (px)	Pinzas (px)
Area	14301	2098	4001	17202	9653
Centroide	[397.1833 230.9185]	[379.5071 223.4542]	[391.3199 206.6723]	[212.7978 143.2284]	[111.0776 111.9689]
MajorAxisLength:	602.2369	271.7864	468.2906	394.3456	186.1630
MinorAxisLength:	62.6371	10.6286	18.2177	195.3851	68.4965
Eccentricity:	0.9946	0.9992	0.9992	0.8686	0.9299
Orientation:	39.8283	44.4084	45.0866	20.4422	18.0417
ConvexArea:	59874	2470	5895	46124	9846
FilledImage:	[393x597 lógica]	[174x178 lógica]	[291x290 lógica]	[261x382 lógica]	[101x167 lógica]
FilledArea:	14314	2154	5429	17805	9663
EulerNumber:	-1	-34	-165	-13	-8

Tests were performed; processed some figures are shown in Table 4 The figures b and c were searched in dye images, and were located. The identification of objects between 70 and 90% correct in real time.

Table 4. Another Figures processed.

Object	Processed image
 a	
 b	
 c	
 d	
 e	

IV. Conclusion

Proper insulation and filtering of various objects in an image is the key to obtaining the correct parameters to use. This means that as a first step it is essential to isolate the object to be detected to determine its basic characteristics that are stored in a database as standards.

You may get plenty of attributes of the object; however some features may highlight them while others are irrelevant. A descriptor storing this characteristic allows us then is compared with a new incoming object to the system.

So to recognize the objects are compared with those obtained in the stored images and to exceed the appropriate threshold Mahalanobis distance can locate the position.

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