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Performance Analysis of Distance Metric for Content Based Image Retrieval

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Abstract*: Content based image retrieval uses different feature descriptors for image search and retrieval. For image retrieval from huge image repositories, the query image features are extracted and compares these features with the contents of feature repository. The most matching image is found and retrieved from the database. This mapping is done based on the distance calculated between feature vector of query image and the extracted feature vectors of images in the database. There are various distance measures used for comparing image feature vectors. This paper compares a set of distance measures using a set of features used for CBIR. The city-block distance measure gives the best results for CBIR.

***Index Terms*: Distance measure, feature descriptors, image search, retrieval, cbir.**

I. INTRODUCTION

The image retrieval using CBIR is based on the distance vectors obtained from the set of feature vectors obtained from the query image and the set of images in the repository. Even though the feature descriptor's efficiency plays an important role, the technique for distance measure also is very important for getting the most accurate result. The generally used distance measures are Euclidean, City-blok, Canberra, Cosine, Hamming etc.

II. PROPOSED METHOD

This paper does a performance evaluation of various distance metrics which are commonly used for CBIR. Tthe performance of distance measures used for comparison are, Euclidean distance, cityblock distance, cosine distance and hamming distances. These distance measures are used with four different conventional features, maLBP, mdLBP, LBP [7] and RGB[8]. maLBP stands for multi channel adder Local binary pattern, mdLBP-multi channel decoder local binary pattern, LBP-local binary patter. The performance is compared using the average precision metric. A comparison of retrieval results obtained for the above mentioned features using all the distance measures discussed earlier are done. The most appropriate distance is chosen as the best distance measure for CBIR. The experiments are conducted over the Wang's dataset .

$$D\{(p_1,q_1),(p_2,q_2)\} = |p_1 - p_2| + |q_1 - q_2| \qquad (1)$$

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Equation.1 helps to find the cityblock distance between two points, $(p_1,q_1)\ and\ (p,q_2)$. The distance between the x coordinates and y coordinates are found separately and the modulus value is added to get the distance [4].

$$D\{(p_1,q_1),(p_2,q_2)\} = \sqrt{(p_1-p_2)^2 + (q_1-q_2)^2} \qquad (2)$$

Equation.2 helps to find the Euclidean distance between two points, $(p_1,q_1)\ and\ (p,q_2)$. The distance between the x coordinates and y coordinates are found separately, the square value is added and the square root gives the exact to get the distance.

Let P is defined as, $P = (p_1, p_2, \dots p_m)$ and let $Q = (q_1, q_2, \dots q_m)$ then the minkowski distance between P and Q is given in Equation.3 [2].

$$D(P,Q) = \left(\sum_{i=1}^{n} |p_i - q_i|^m\right)^{1/m} \qquad (3)$$

The cosine distance is calculated by finding the angular distance between the two points. The distance between two points, m and n can be calculated using Equation.4 [3].

$$d_{mn} = 1 - \frac{p_m p'_n}{\sqrt{(p_m p'_m)(p_n p'_n)}} \qquad (4)$$

Hamming distance gives the percentage of coordinates that differ from each other. Equation.5 gives the equation for hamming distance [3].

$$d_{st} = \%\left(\frac{x_{sj} \neq x_{tj}}{n}\right) \qquad (5)$$

The precision is calculated using Equation.6 [7].

$$P = \frac{No.relevant\ images\ retrieved}{Total\ number\ of\ relevant\ images} \qquad (6)$$

The precision value P is calculated using two important parameters, $'No.relevant\ images\ retrieved'$ and $'Total\ number\ of\ relevant\ images'$.

III. EXPERIMENTS AND DISCUSSIONS

The three distance measures are applied on wang's database for image search and retrieval when four different features are used. The wang's database consists of 1000 images. The images in wang's are classified in 10 classes where each single class has got hundred different images. The images from the database are retrieved using maLBP, using the three distance measures.

For each of these experiments the average class wise precision is calculated and then the best distance measure is found based on the performance. The experiment is repeated for the remaining three features.

Table.1 shows the average precision obtained for retrieval of 20 images using maLBP feature with different distance measuring techniques. Table.2 shows the average precision obtained for retrieval of 20 images using mdLBP feature with different distance measuring techniques. Table.3 shows the average precision obtained for retrieval of 20 images using LBP feature with different distance measuring techniques. Table.4 shows the average precision obtained for retrieval of 20 images using RGB feature with different distance measuring techniques.

Table.1 Average precision obtained using maLBP feature using the selected distance measures

Categories	maLBP			
	Hamming	Euclidean	Cosine	Cityblock
Africans	35.95	47.45	53.35	57.9
Beaches	23	36.2	39.55	45.15
Buildings	35.9	45.85	45.65	58.9
Buses	56.65	67.7	78.85	88.75
Dinosaurs	78.4	96.25	95.9	97.85
Elephants	30.95	35.95	40.05	44.45
Flowers	75.6	71.6	74.05	86.45
Horses	45.3	59.05	69.7	70.8
Mountains	25.55	27.95	31.55	33.9
Food	37.7	47.75	52.25	62.15
Average	**44.5**	**53.575**	**58.09**	**64.63**

Table.2 Average precision obtained using mdLBP feature using different distance measures

Categories	mdLBP			
	Hamming	Euclidean	Cosine	Cityblock
Africans	42.8	56.2	58.45	64.25
Beaches	12.95	37.15	40.45	47.9
Buildings	34.45	46.55	43.95	60.4
Buses	6.65	71.95	74.6	88.75
Dinosaurs	22.3	96.05	95.55	97.8
Elephants	20.55	40.4	42.45	47.4
Flowers	19.8	65.25	61.5	83
Horses	42.75	68.9	70.1	77.4
Mountains	20.35	30.2	32.3	34.7
Food	7.3	47.25	44.25	61.55
Average	**22.99**	**55.99**	**56.36**	**66.315**

Table.3 Average precision obtained using LBP feature using different distance measures

Categories	LBP			
	Euclidean	Cityblock	Cosine	Hamming
Africans	**Hamming**	**Euclidean**	**Cosine**	**Cityblock**
Beaches	25.9	49.8	50.9	54.85
Buildings	28.6	36.5	39.4	47.7
Buses	24.9	33.8	38.3	46.45
Dinosaurs	30.2	72.9	76.05	87.75
Elephants	65.2	94.7	98.3	97.4
Flowers	25.4	28.85	29.55	34.6
Horses	63.4	68.8	77.65	82.75
Mountains	27	62.9	61.75	66.75
Food	18.5	28.1	29	33.35
Average	**21.1**	**43.1**	**44.85**	**51.05**

Table.4 Compares average precision obtained using RGB feature using different distance measures

Categories	RGB			
	Hamming	Euclidean	Cosine	Cityblock
Africans	12.65	59.05	59.9	63.95
Beaches	37.8	40.05	40.95	43.1
Buildings	38.95	35.15	37.45	45.45
Buses	9.25	50	44.9	53.35
Dinosaurs	63.8	99.8	99.85	99.95
Elephants	10.75	49.05	48.1	53.35
Flowers	37.85	55.35	64.6	66.5
Horses	16.1	85.55	88.25	91.2
Mountains	25.6	33.5	34.4	39.25
Food	10.8	64.05	61.05	67.8
Average	**26.355**	**57.155**	**57.945**	**62.39**

A. Result Analysis

A shown in Table.1 when the maLBP feature is applied for image retrieval the city block distance method shows 6.54%, 11.055 and 20.13% increment than cosine, Euclidean and Hamming distance measures respectively. In Table.2 when the mdLBP feature is applied for image retrieval the city block distance method shows 9.955%, 10.325 and 43.325% increment than cosine, Euclidean and Hamming distance measures respectively. Table.3 has the average precision values obtained when the LBP feature is applied for image retrieval the city block distance method shows 5.69%, 8.32% and 27.245% increment than cosine, Euclidean and Hamming distance measures respectively. Table.4 has the average precision values obtained when the RGB feature is applied for image retrieval the city block distance method shows 4.445%, 5.235% and 36.035% increment than cosine, Euclidean and Hamming distance measures respectively.

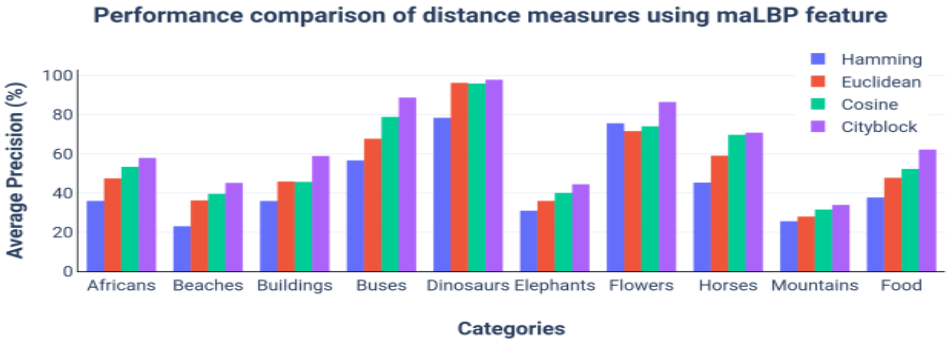

Figure.1 Graphical representation of retrieval results using maLBP

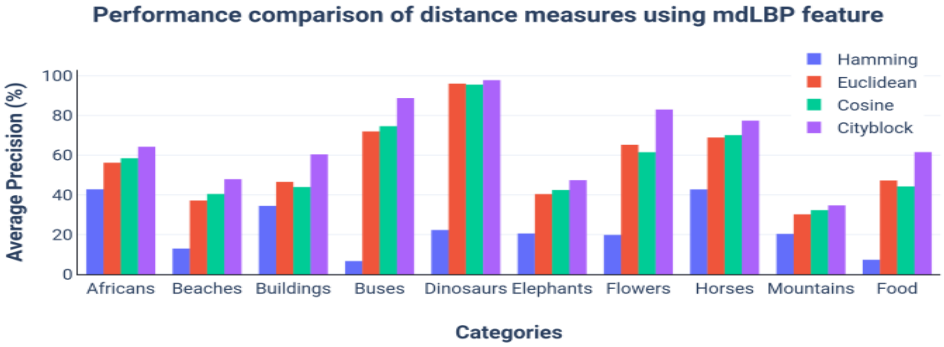

Figure.2 Graphical representation of retrieval results using mdLBP

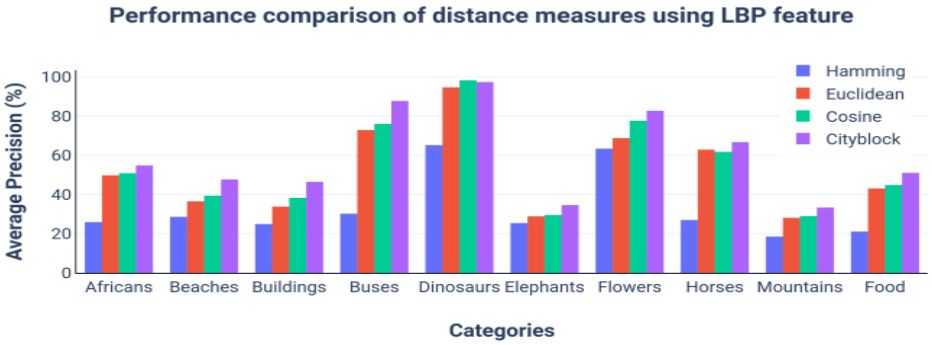

Figure.3 Graphical representation of retrieval results using LBP

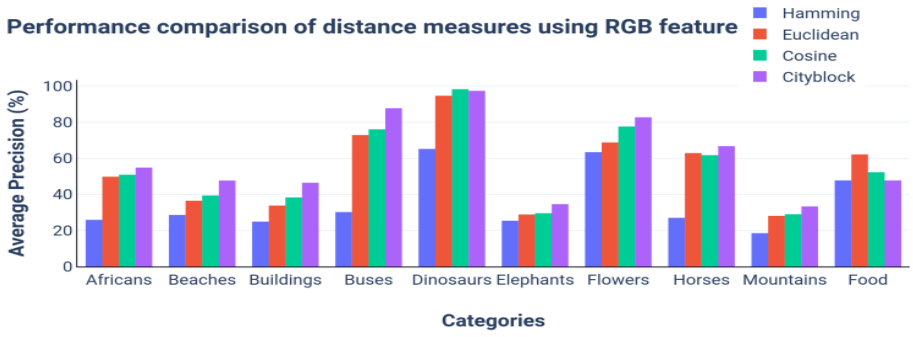

Figure.4 Graphical representation of retrieval results using RGB

IV. CONCLUSION

This paper implemented different distance measures over the wang's dataset and compared the results obtained for content based image retrieval using four features. The features used are, maLBP, mdLBP, LBP and RGB. The results infer that the cityblock distance measure gives the best results for CBIR. City block distance measure got an average improvement of 12.575%, 21.202, 36.035% and 15.083% improvement when the maLBP, mdLBP, LBP and RGB features respectively are used for retrieval.

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