Abstract—This study presents the comprehensive survey and effectiveness of several shape measures for content based retrieval system. Shape features contain the most effective visual information for individual observation. In image retrieval system, depending on the application some require shape representation to be invariant to translation, rotation, scaling while other do not.

Keywords: Shape retrieval, Methods, properties, Representations, Descriptor.

I. INTRODUCTION
An enormous work has been done on the promising field of multimedia and image retrieval systems. Image retrieval system has been popular for several years. Many different systems are design for content based image retrieval (CBIR). A content-based retrieval is used to search query from database based on visual characteristic. CBIR system depends on important visual contents ie. Color, Texture, Shape, Size, Spatial details of an image. These features can be extracted by using image processing tools and compared to the features of the query image. Combination of these features are achieve higher level of retrieval accuracy. Efficiency and accuracy are two important concepts in designing a content-based system.

This paper presents the analysis and effectiveness of several shape measures for content based retrieval system of images. Shape refers to the information that can be infer directly from images and that cannot be represented by color or texture. Shape defines a complementary space to color and texture. Shape features contain the most effective visual information for individual observation. The fundamental concern is the characterization of image content and retrieval of images based on similarity of image content. Similarity based image retrieval process is also called the contents based image retrieval where in the images are searched and retrieved based on the visual content of the image. Shape is a fundamental robust image feature used in content-based image-retrieval systems. Shape representation and description is a difficult task. This is because when a 3-D real world object is projected onto a 2-D image plane, one dimension of object information is lost [7]. The primary mechanism used for shape based retrieval included identification of feature such as lines, boundaries, aspect ratio, circularity, fourier description moments invariants, consecutive boundary segments and by identifying areas of changes or stability via region growing and edge detection methods.

Problem: Overlapping areas
: Touching shapes

Shape feature utility is useful in many domain specific areas like man-made objects. Shape feature is characterising by the perimeter centroid of an object. Most widely used feature can be grouped as shape and texture, shape is one of the most important characteristic of an object in CBIR system. the problem often refers to finding a particular shape of an object or the queried images which requires image segmentation after segmented, the shapes of an object may be described.

II. RELATED LITERATURE WORK
Various author and researcher gave their assumption and study for shape based retrieval of an image. Basically shape representations techniques used in similarity retrieval that are generally characterized into contour-based and region-based techniques.

Babu M. Mehtre et al. [11] provides the comparison analysis of various shape measures for content based image retrieval. Shape feature is getting by an image or sketch. In a simple way eccentricity & orientation are also called shape feature. Two basic approaches are used to perform the shape analysis: Region based and Boundary based (contour based). Region based system typically use moments descriptions like: Geometrical moment, invariant moments, Zernike moment, Legendre moment. Boundary Based system typically use contour of the objects and usually give better results. Contour based techniques include: chain code based string features, Fourier Descriptor, Curvature Scale space methods.

Pheerawit et al. [6] gave the approach i.e. Shape based information extracted by using image contour features which emphasis shape based retrieval and data mining techniques to find significant knowledge in the image data base. This paper focus on combining approach of image feature and data mining techniques. The Rough set theory is used to generate rule based system and classify them.

Sami Brandt et al.[2] proposed the most well known technique for feature vector extraction was region based descriptors which do not demand object segmentation rather the shape features are edge histograms and Fourier-transform-based features computed for an edge image in Cartesian and polar coordinate planes.

Anil K Jain et al.[3] gave this report deals with efficient retrieval of images from large databases based on color and shape. This approach relies on image features that exploits visuals cues such as color and shape,. This report also demonstrates that combination of clustering and branch and
bound based indexing scheme for improving the speed of retrieval.

C. Sheng et al.[7] proposed Shape-Based Image Retrieval Using Shape Matrix a new method for the representation and comparison of shapes is present which is based on the shape matrix and snake model. It is scaling, rotation, translation invariant & it can retrieve the shape images with some missing or occluded parts. In the method, the deformation spent by the template to match the shape images and the matching degree is used to evaluate the similarity between them.

Xiang-Yang Wang et al. [12] proposed a color image retrieval scheme by combining color, texture and shape information. Robustness with respect to the image scale, Illumination and Noise are some of the important aspects to be considered in developing image matching systems.

Shao-Hu Peng et al. [17] describes a visual shape descriptor based on the sectors and shape context of contour lines to represent the image local features used for image matching. The descriptor consists of two-component feature vectors ie. the local region is separated into sectors and their gradient magnitude and orientation values, a feature vector is then constructed from these values. Second, local shape features are obtained using the shape context of contour lines. Another feature vector is then constructed from these contour lines. The approach calculates the local shape feature without needing to consider the edges. This can overcome the difficulty associated with textured images and images with ill-defined edges. It is more robust to image scale changes, illumination variations and noise.

S. P. Mathew1 et al. [15] proposed a shape measure i.e. based on Convex Hull Geometry. The proposed approach is based on the shape signature extracted by employing color based segmentation, edge detection and extraction of the convex hull. When an image is queried, the system determines the shape signature for the image and then computes the similarity measure between the signatures of the query image and the existing database based on the convex hull area ratio (CHAR) comparison and retrieves a specified number of the best matches. The metric CHAR is the ratio of the area of the intersection of the two convex hulls to the area of their union.

A. Srinagesh et al. [16] This paper offer a new Modified Shape Descriptor (MSD) feature extraction technique which is used as descriptive feature to discriminate objects in an image database. In this shape structure is detected using edge detection technique with threshold method to generate the shape feature vector.

III. PROPERTIES OF SHAPE FEATURES

Following properties are given below of shape measure:

Identifiability:

Shapes which are found perceptually similar by any individual have the same features that are different from the others.

Translation, Rotation & Scale Invariance:

In the image shape, changing the location, rotation and the scaling must not affect the extracted features.

Affine Invariance:

The affine transform performs a linear mapping from coordinates system to other coordinates system that preserves the “straightness” and “parallelism” of lines. Affine transform can be constructed using sequences of translations, scales, flips, rotations and shears.

Noise Resistance:

Features must be as robust as possible against noise, i.e., they must be the same whichever be the strength of the noise in a give range that affects the pattern.

Occultation Invariance:

When some parts of a shape are occulted by other objects, the features of the remaining part must not change compared to the original shape.

Statistically Independent:

Two features must be statistically independent. This represents compactness of the representation.

Reliability:

As long as one deals with the same pattern, the extracted features must remain the same.

IV. APPLICATIONS OF SHAPE MEASURES

Based on the shape measures retrieval various applications are generated day by day. Some of them are:-

* Rough draft Recovery
* 3D object recognition and Analysis
* Blueprint Structure detection
* Medical Imaging
* Image Graphics
* Animatronics design

V. REPRESENTATIONS AND DESCRIPTORS OF SHAPE RETRIEVALS

An image can be described by its local and global features, which are related contour of the shape. Generally shape representation and description techniques can be generally classified into two classes: contour-based methods and region-based methods. The classification of shape features extraction is based on the contour only or the complete shape region. The classification is further divided into Boundary based and Region based.

Simple shape descriptors, are common global descriptors, i.e. area, circularity, eccentricity, major axis orientation. These descriptors discriminate shapes with big differences. Standalone shape descriptors like, eccentricity of the shape is does not correctly explain the shape, because perceptually it is an stretched out the shape. For this circularity is a better descriptor. Other simple global boundary based shape descriptors have been proposed by Peura and Iivarinen. These descriptors include convexity, ratio of principle axis, circular variance and elliptic variance, moment invariant and aspect ratio.
Shape context
Shape context is a feature descriptor used in recognition process. It is first defined by Belongie (2002), describes the relative spatial distance and orientation, or distribution of landmark points around feature points. Shape context can be defined with n sample points $x_1, x_2, \ldots, x_n$ on a given shape. Shape context at point $x_i$ is a histogram $h_i$ of the relative coordinates of the remaining $n-1$ points:

$$h_i = \#\{x_j : j \neq i , x_j - x_i \in \text{bin}(k)\}$$

where bins divide the log-polar space uniformly, and the distance between two Shape context histograms is defined using the chi square statistic[18].

Contour extraction
Contour can be obtained by separating the object information from its background details. This is done by converting the given image into a gray scale image Fig. (a). After it is then binarized and obtain the counter of gray scale image Fig. (b).

Convex hull derived from the brain’s surface was identified as the basis for automating and standardizing global spatial normalization. Their idea was to match the position, orientation and dimensions of the brain to that of a standard atlas brain. Convex hull area ratio (CHAR) comparison and retrieves a specified number of the best matches. The metric CHAR is the ratio of the area of the intersection of the two convex hulls to the area of their union.

Chain code
It is a sequence of no. representing direction when following the contour of an object. Basically this technique is used to represent the boundary of an object. Two different approaches are used 4 direction and 8 direction. The drawback of any small disturbance along the boundary due to noise or imperfect segmentation cause changes in the code that may not be related to the shape of the boundary.

Polygonal Approximation
A digital boundary can be approximated with arbitrary accuracy by a polygon. Polygon approximation techniques is a exact for closed curve, when the no. of segments in the polygon is equal to the no. of points in the boundary. The goal of polygon approximation is to capture the “essence” of the boundary shape with the fewest possible polygon segments.
Signature

Signature is a one dimensional function representation of a boundary. The main advantage of this method is simplicity. The distance versus angle is not the only way to generate a signature, another way is to traverse the boundary and corresponding to each point on the boundary, plot the angle between a line tangent to the boundary at a point and a reference line.

Skeletons

An important approach to representing the structural shape of a plane region is to reduce it to a graph. The skeleton of a region may be defined via the medial axis transformation (MAT) proposed by BLUM [1967].

Shape Number

The shape no. of a boundary is defined as the first difference of smallest magnitude. The first difference of the chain coded boundary depends on the starting point. The number of digits in the shape number is called the order n of the boundary.

Fourier descriptors:

The fourier coefficients are called fourier descriptors which is a way of using the fourier transform to analyze the shape of a boundary. The basic shape of the region is determined by the first several coefficients, which represent lower frequencies and higher frequency terms provide information on the fine detail of the boundary. For a continuous boundary, it is descritized and represented as a digital boundary.

The digital boundary has N points, each point can be represented as a spatial coordinates pair (X(u),Y(u)) (X1,Y1) (X2,Y2) ............ (Xn-1,Yn-1). All these coordinates can be expressed as a sequence.
P(l)= X[l], Y[l] where l=0,1,2,...............N-1
The coordinates pairs can also be represented in the complex number.
P(l)= X(l)+jY(l) for l=0,1,2,...........,N-1

By using the complex number representation the boundary itself has not been changed. The discrete fourier transform of p(l) is then defined as

N-1
A(u)= \frac{1}{N} \sum_{l=0}^{N-1} p(l)e^{-j2\pi ul/N} \quad \text{for } u=0,1,2,3,.............N-1

L=0

The complex coefficients A(u) are called the fourier descriptors of the given boundary. The inverse transform of A(u) restores the P(l) and the same is given in eq.

N-1
P(l)= \sum_{u=0}^{N-1} A(u)e^{j2\pi ul/N} \quad \text{for } u=0,1,2,3,.............N-1
U=0

While restoring the boundary P(l) it is not always necessary to use all the fourier coefficients A(u), let us use only M coefficients to restore P(l), usually M is much less than N. Then the reconstructed boundary will have a shape close to the original boundary. If M is too less compared to N, the reconstructed boundary will have a shape which is much deviated from the original boundary. Then the reconstructed boundary is an approximation to the original boundary.

Moments:

The boundary shapes can be well described quantitatively by using moments. In order to explain the use of moments, a portion of the boundary. The one-dimensional representation of the segments(a) using a reference line very close to the segment and the function g(r), let the amplitudes of the function at regular intervals be treated as a random variable u and denoted as P(u) for i=1,2,...............k where k is the number of discrete samples used. Then the n^th moments of u about its mean is :

\mu_n(u) = \sum_{i=1}^{k} (u_i - m)^n p(u_i)

m = \sum_{i=1}^{K} u_i p(u_i)

The quantity m is the mean or average of \mu_1 and \mu_2 as it variance. In general only first few moments are required to differentiate between boundary of different shapes . the second moments \mu_2(u) measures the spread of the curve about the mean value of r and third moments \mu_3(u) measures its Symmetry with reference to the mean.

Region representation:

The shape of the region may be directly represented by the region it occupies. For example, the binary array:

\[ u(m,n) = \begin{cases} 
1 & \text{if } (m,n) \in R \\
0 & \text{otherwise} 
\end{cases} \]

is a simple representation of the region R boundaries. Boundaries give an efficient representation of region because only a subset of u(m,n) is stored.

Run-Length codes:

Any binary region or a binary image can be viewed as a sequence of a alternating strings of ones and zeroes. Run length code can be used to represent these strings. The run length codes consist of the start address of ones or zeroes followed by the length of that string. A binary image and run length code used to represent the image. There are several form of run length code that are aims to minimize the number of bits required to represent the binary images.

Quad tree:

The given region is enclosed in a rectangular area before we apply the quad tree procedure. Then the areas divided into four quadrants each of which is examined if it is totally black or totally white. The quadrant that has both black as well as white pixel is called grey and further it is divided into four quadrants. Then the tree structure is generated until each sub quadrant either only black or white. The tree can be encoded by a unique string of a symbols b(black), w(white),g(grey). The procedure so far discussed is illustrated. The tree can be encoded by a unique string using
white(w), black(b), grey(g). letters and the code thus obtain is Code: g w g b w b g w w b b b

**Euler number:**
The euler number can also be as a topological descriptor the same is given in term of holes H and connected component C. The euler number E of the region consist in of H holes and C connected components can be by the given expression: E = C - H. The euler number can be applied to straight line segment such as polygonal networks.

**CONCLUSION**
Shape is a fairly well defined concept of general applicability. for shape representation of image converting it into binary polygonal approximation that uses straight line Bezier curve and Bspline are applied. As a result the image is presented as a set of straight lines arcs, and curves. From the discussion so far, it is quite clear that shape is one of the primary visual features in CBIR.

**REFERENCES**
[19] Dengsheng Zhang and Guojun Lu “Content-Based Shape Retrieval Using Different Shape Descriptors: A Comparative Study”