JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Edge Detection and Pattern Matching Technique for Recognition of Objects in a Group.

Channakeshava RN
Assistant Professor, Department of Computer Science, Government Science College, Chitradurga.

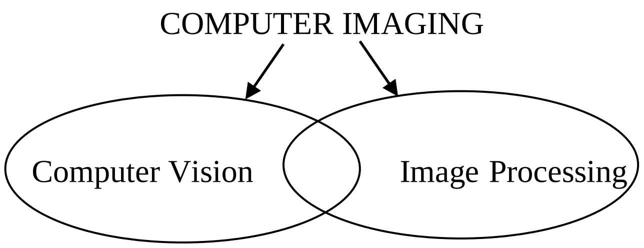
Abstract: Many a times, capturing photography/picture/an image, in the way we desire perhaps may be difficult task and sometimes due to inherent limitations it could even be impossible. For instant, it is possible to capture an ideal front view of a wild life animal. There are many such instances where pragmatic situations impose limitations on capturing the image the way we desire. In such situation, instead of capturing the ideal image, which turns out to be just impossible can capture the object in terms of multiple, partial, overlapping images and compose them into a single image, which turns to be one well-formed image.
Keywords: Mosaicing, Edge, Pattern, chain codes.

1. INTRODUCTION

Humans perceive and understand the world by the help of different sense organs, and vision is also a sense. same as we do computers also has vision and it duplicates the effect of human vision by electronically understanding an image, now a day we are also coming across 3D world where computers are able to analyze 3D world.

When the world is giving 3D information and the computer processes it as a 2D image, lots and lots of information is lost, in the form of a dimension. Analyzing such information may or may not give desired result.

Images are handled by computers in two steps; 1. Capturing an image and 2. Processing an image. Where an imaging device such as camera or a scanner etc captures an image and gives digital form of that image. Image processing has many different modes of operations to work with that image to get some targeted result. Image processing does many different jobs such as identifying for a particular object in the image, enhancing an old image, convert old black and white (Grayscale) image to colour image, joining more than one image etc.



Two levels of computer image are distinguished as; 1. Image processing (low level). 2. Understanding an image (High level).

Noise removal, edge detection, segmentation, image compression, sharpening an image, etc are low level image processing techniques which give details helpful for understanding the image.

High-level processing adapts advanced artificial intelligence methods to understanding image and processing the image such as; identifying vehicle number by decoding image of the number plate, detecting traffic signal violation, joining more than one images based on their adjacency, etc. high level image processing are normally domain based applications. High level computer image processing normally uses cognition and ability to make decisions by imitating human nature

2. REQUIREMTS OF DATA FOR IMAGE ANALYSIS.

Establishing a relationship between input image and real world is the idea of image perception and processing. As the raw input image is transformed to models, image information becomes become denser and denser. To analyzing the image we must arrange the data into several levels of data structures, which comprises two major parts; 1. Data structures (intermediate representations) 2. Algorithms used for the creation of those representations.

Traditional Image Data Structures.

Relational databases, Matrices, chain codes, graphs list of object properties etc are traditional data structures required for image processing.

Direct representation of image information and more complex hierarchical methods are is done with the help of relational databases.

i. Matrices.

Most common low level representation of image is a matrix. Each element of the matrix may correspond to brightness level which may be represented by an integer. Coordinates of an image pixel will be corresponds to the row and column indices of a matrix.

ii. Chain codes.

Boundary of a connected sequence of straight or a curved line is defined in chain codes. Chain codes also contain length and direction of those lines the representation may be defined as 4 or 8 based connectivity.

iii. Topological data structures.

Image is divided into se of elements and relations and stored as topological data structures. graphs are used to represent topological data structures.

G = (V,E) is a graph consisting of set of nodes, V = {V1, V2,…. Vn} and a set of edges E = {e1, e2, … en}. Where ek edge may be incident to an unordered pair of nodes {V1,V2}.

iv. Hierarchical data structures.

In hierarchical data structures, instead of storing entire image data, we make use of only essential data required for further processes. In order to speedup processing small quantities of data is used by the algorithms and those algorithms will decide the strategies for further processing of that data.

SURVEY OF LITERATURE

1 Correlation based image mosaicing:

A basic statistical approach by template matching or pattern recognition is Correlation [1]. It is a match metric, i.e, it gives a measure of the degree of similarity between an image and a template. For a template T and image I, where T is small compared to I, the two dimensional normalized cross-correlation function measures the similarity for each translation is given by;

$$C(u,v)=\frac{\Sigma x \Sigma y\, T(x,y)\, I(x-u,y-v)}{[\Sigma x \Sigma y\, I^2(x-u,y-v)]^{1/2}}$$

Thus by computing C over all possible translation, it is possible to find the degree of similarity for any template sized window in the image.

2 Moment based Image Mosaicing.

Regions and objects of interest in an image are identified using texture spatial feature. Texture is also a principal feature for pattern recognition and image processing.

Texture provides vital information about the arrangement and spatial properties. Various pattern recognition methods are used to describe and classify different texture images.

These features can then be used for description or classification of different texture images using any one of a multitude of pattern recognition techniques.

In moment based mosaicing, texture features are used to find the overlapping region between the images to be mosaiced. In this method, first order moment, second order moment, and third order moment, are chosen as texture features for matching. Features of first images are extracted and matched with the second image. For the best match, coordinates are noted and overlap region is detected. Once the overlapping region is found, the second image is translated to get a single large image.

[5] Image Mosaicing Using Binary Edge Detection, edge detection is used by adapting sober filters and binary techniques

First order moment.

Information about the general brightness of the image is derived using the mean (Average value), High mean indicates high brightness. A dark image will have less value for mean.

Let L be the total number of gray levels or colours available. The gray levels vary from 0 to L-1;

Ex: for a typical 8-bit image, L is 256 and its value ranges from 0 to 255.

We can define the mean as follows:

$$\mu = \sum_{r=1}^{r=row} \sum_{c=1}^{c=col} \frac{I(r,c)}{M}$$

Where, r is the row coordinate.

C is the column coordinate.

I is the intensity value.

M is the total number of pixels.

Second order moment

The standard deviation, which is also known as the sequence root of the variance, tells us some some thing about the contrast. It describes the spread in the data, so a high-contrast image will have a high variance, and low contrast image will have a low variance. It is defined as follows:

$$\sigma_g = \sqrt{\sum_{g=0}^{l-1} (g-\mu)^2 P(g)}$$

Third order moment:

This order is for more contrast variance in the image and it is as follows:

$$\sigma_g = \sqrt{\sum_{g=0}^{l-1} (g-\mu)^3 P(g)}$$

Histogram Based Image Mosaicing.

In the previous chapter, moment based mosaicing was discussed and was shown to be more effective than the correlation based approach. Even though it was more effective than correlation, the time taken by moment based method is very high so, in this chapter normalized histogram intersection method which takes less time when compared to other methods is proposed.

Gray level values against the number of image pixels plotted are called histogram. Nature of the image or a sub image if an image contains other image within that can be known by the shape of the histogram.

Statistically based features of histogram are considered, as probability distribution of gray levels. These statistical features provide information about the image characteristics of gray level distribution.

Consider a histogram with gray levels ranging [0,L-1] of a digital image. Its discrete function be $p(r_k)=n_k/n$.

k^{th} gray level is r_k.

number of pixels of that gray level in that image is n_k.

Total number of pixels the image having is n.

$k=0,1,2,3,\ldots L-1, p(r_k)$.

Global description of the appearance of an image is given by all values of k.

Ex: consider an image with 3bits/pixel depth. Possible values will be in the range 0 – 7.

Then histogram for the image may be as follows:

Values of gray level	Number of pixels
1	10
2	8
3	9
4	2
5	14
6	1
7	5
8	2

3. EDGE BASED IMAGE MOSAICING WITH PATTERN RECOGNITION.

In this chapter a new method for mosaicing images based on the edges is proposed. In this method edges patterns are used to find the overlapping region between the images. Since edges are used, we work on edge space instead of image space. Thus the time complexity and search space is reduced and process of mosaicing is fast compared to other methods.

Contours of images of objects or, in other words, In the image processing and computer vision paradigm edges provide good amount of information similar to human image understanding.

Edge detection process involves edge probabilistic calculations for human picture recognition. Edge detection in computer image processing is a high level challenge for scientists.

How do edges come in an image? Probably, the answer to the question provides the early important clue for locating edges in an image. Image consists of variations in brightness levels leads to edges. Other features may also contribute to edges.

Clearly edges represent discontinuity of image intensities in image, there may be various reasons like lighting conditions, geometry, type of materials, etc., as well as their mutual interactions, for the discontinuities.

The intensity or brightness variation tells the application of derivative operators for detecting edges.

The application leads to another image which holds rate of intensity variation, this image is called gradient image.

Application of derivative operators on intensity image produces another image, usually called gradient image as it reveals the rate of intensity variation. In order to yield contours, the gradient image is processed with thresholdng or edge linking.

Edge Detection.

The process of detecting the edges of a given image for feature extraction or detection, segmentation, motion analysis of the contour objects. Edges in the paradigm of image processing and computer vision provide valuable information towards human image understanding.

Edge enhancement by using prewitt and sobel operator: the gradient g’(r,c) at pixel (r,c) is obtained by a point operator applying on all of its neighboring pixels of mask size 3x3 for detection to variation in pixels intensity value. Edge detected by using sobel operator is as shown in Fig 6.6.

g2	g1	g8
g3	g0	g7
g4	g5	g6

Fig: edge Detection 3X3 Mask.

a. **Prewitt operator:** weights are assigned to all the neighbours of the candidate pixel whose edge strength is being calculated.

d1= $1/3 [(g_4 + g_5 + g_6) – (g_2 + g_1 + g_8)]$

d2= $1/3 [(g_8 + g_7 + g_6) – (g_2 + g_3 + g_4)]$

The corresponding masks are given by.

-1	-1	-1
0	0	0
1	1	1

-1	0	1
-1	0	1
-1	0	1

Fig (a) Horizontal mask **Fig (b)** Vertical mask

b. **Sobel operator:** in sobel operator more valued weights are assigned to the pixels close to the candidate pixel.

d1= $1/3 [(g_4 + g_5 + g_6) – (g_2 + g_1 + g_8)]$

d2= 1/3 [(g_8 + g_7 + g_6) – (g_2 + g_3 + g_4)]

The corresponding masks are given by.

-1	-2	-1
0	0	0
1	2	1

-1	0	1
-2	0	2
-1	0	1

Fig (a) Horizontal mask **Fig (b)** Vertical mask

Thinning:

On a gray scale image, multi pixel wide edges may also be there edge detection technique must be able to detect them. Detection of such pixels may not be possible with simple edge detection techniques as they will not meet the intensity variation parameter. Industrial specific inspection and measurements are required for detecting such precise edges. It usually needs some processing to reduce the width of the edge elements. As shown below in fig 6.7.

Thinning is basically a search and delete process that removes only those boundary pixels whose deletion.

1. Don't change connectivity of their neighbors locally, and.
2. Don't reduce the length of an already thinned curve.

The pixels whose deletion changes the connectivity of its neighborhood locally is called "critical pixel". The pixel whose deletion reduces the length of an already thinned curve is called an "end pixel". Number of neighboring pixels of an end pixel is less than two.

Algorithm for thinning binary region; in a region specification background points will have value 0, and region points will have value 1. This method consists of repetitive passes of two basic steps.

Step 1.

a. 2<=N(p)<=6.
b. S(p)=1.
c. P2*P4*P6=0.
d. P4*P6*P8=0

Where N(P1) is the number of non zero neighbor's of P1 that is,

N(P1)=P2+P3+P4+P5+P6+P7+P8+P9,

P9	P2	P3
P8	P1	P4
P7	P6	P5

And S(P1) is the number of 0 to 1 Transition in the ordered sequence of P2,P3,….P8,P9,P2,

Step 2:

Conditions (a) and (b) remains the same, but condition (c) and (d) are changed to,

C'.P2*P4*P8=0.

D'.P2*P6*P8=0.

Step 1 is applied to every border pixel in the binary region under consideration. If one or more of conditions (a) to (d) are violated, the value of the point in question is not changed. If all conditions are satisfied the point is flagged for deletion.

Thus, one-iteration of the thinning algorithm consists of,

1. Applying step 1 to flag border points for deletion;
2. Deleting the flagged points;
3. Applying step 2 to flag the remaining border points for deletion; and
4. Deleting flagged points.

This basic procedure is applied iteratively until no further points are deleted at which time the algorithm terminates.

Corner Matching

In the matching stage we correlate the edge pixels in the 9x9 template that is centered by the corner pixel in one image to the following image in the sequence. As we said above the correlation of the template is not done on the entire image. The assumption of the slight y movement and the putting threshold on the x direction movement improved our correlation method. Without this assumption the mismatches are inevitable. The scoring method that we used basically gives penalty to the mismatched edge pixels and rewards the matches. We observed that the choice of the window size for the matching template is crucial for getting good matches. As the window size gets larger the small group of edge pixels covered, which makes the scoring scheme difficult. But giving penalty to the unmatched edge pixels sometimes improve the optimal match case, although the matches are not perfect. We think that the reason for not getting perfect matches although there is almost no rotation, is that the slight contrast difference between the images of the same area resulting in different edge pixels. But the results that we get from the edge based mosaicing was satisfactory.

Corner Detection

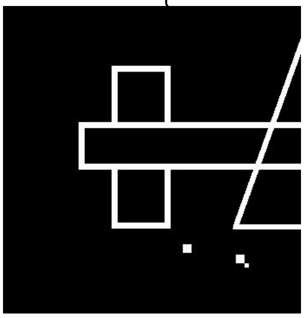
A corner provides another major shape feature used in objects matching and registration. Thus the corner detection is an important step in many image analyses and object recognition procedure, simply speaking, a corner is an image point with high contrast along all the directions. That means all the corner points are also edge points. This directional contrast is measured with respect to a symmetric neighborhood centered on the concerned pixel.

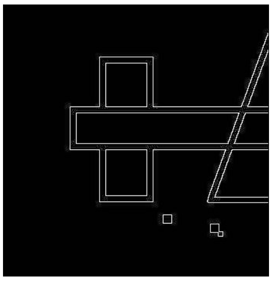
Corner detection is based on the concept that the directions of the forward and backward vectors of non-corner point will cancel each other to detect corners (straight lines). The bending value is used to access the degree of possibility of a point being a corner. Corner finding algorithm which will be useful for dominant point detection, the method involves two steps:

1. Estimate the curvature of each point on the curve by a bending value, and.
2. Locate those with local maximum bending values as corners.

Object corner are detected vector magnitude is as sown below in Fig.

$$P(x,y) = \cos^{-1}\left(\frac{\overline{x} * \overline{y}}{|x| * |y|}\right)$$





The contour tracking algorithm can be summarized as follows.

Step 1: Locate the first point p1(x1,y1) on a curve.

Step 2: Search for the untracked 8-connected neighbors (as shown below Fig.) of point P1 in clockwise direction, and the first detected neighbor is point Pi, i=2.(If there is no untracked neighbor, then the tracking procedure terminates.)

Step 3: Point pi is considered as the tracking point. Determine the number of untracked 8-connected neighbors of the tracking point, saying Nu. Three possible cases can be considered as follows.

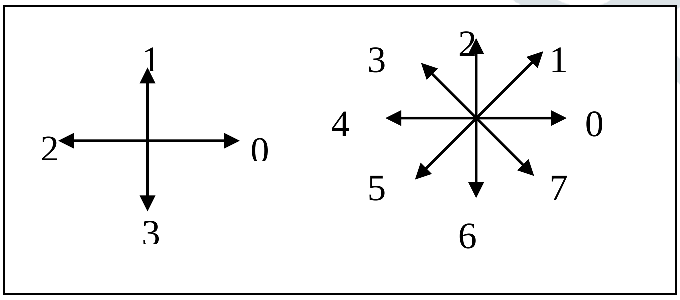
1. If Nu=0, then the tracking procedure terminates (a curve chain ends).
2. If Nu=1, then the unique neighbor is taken as the next tracking point, pi+1.
3. If 2≤Nu≤7, then determine the next tracking point by selecting the neighbor with the smallest value of N(Qj) as the next tracking point. If there is more than one candidate point, then the point with the smallest direction change is selected.

Step 4: Set I = i+1 and go to Step 2.

Chain codes.

Boundaries in an image are represented by chain codes. Chain codes contain straight line segments of specified length and direction.4 or 8 connectivity segments are used in chain codes. Directions are detailed as in the image below.

[6] uses chain codes to detect edges of face recognition using chain codes, canny edge detection and skin color model.



Proposed methodology.

Digital images are captured in a pixel format with x,y directions are used as coordinates, they can be processed as same as grid format. By assigning a direction to each segment connecting every pair of pixels are represented clockwise.

Edge features of the object are thinned into a single pixel-wide for tracing and detecting the corners of the object based on thresholding factor, then representing polygonal approximation using these corner points, finally matching the polygons using directional codes chain.

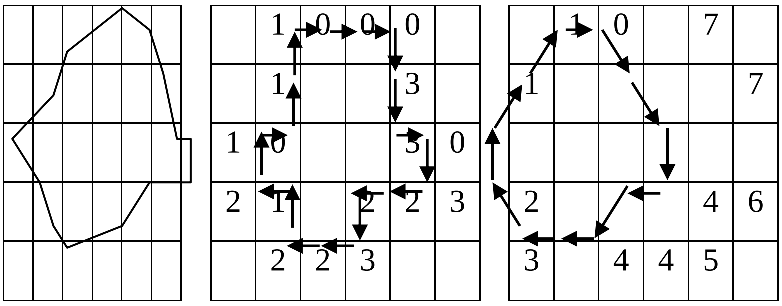
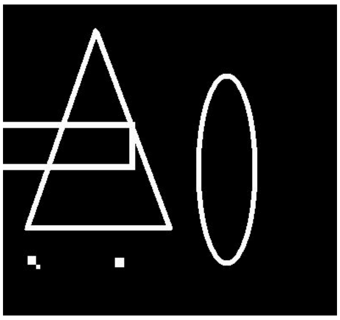
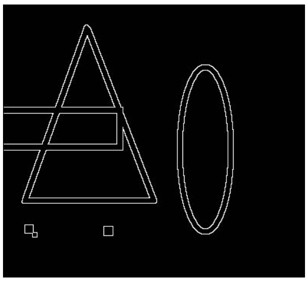
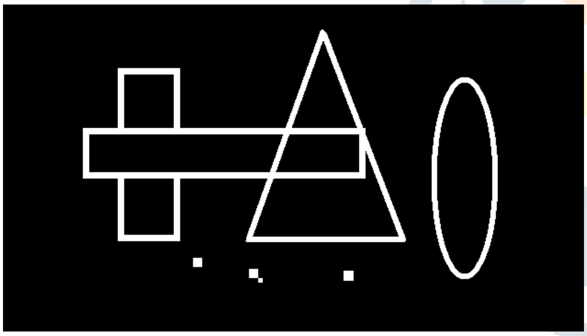


Fig. Detecting chain code 4 directional and 8-directional







5. CONCLUSION

This was an entirely different approach. The approach generates mosaiced image for any applications. The results gives exactly combined image without any distortion and the resulting image looks like what was intended.

The proposed approaches are based on the assumption that the images being planer, distortion free and sequence images are assumed to share a maximum overlapping region. The proposed method is implemented ob planar images by estimating best matching for to detect overlapped region present in between the images by using maximum correlation matching method, moments based texture matching method, normalized histogram intersection method and directional chain code.

These methods are used to eliminate redundant information present in the sequence of continues images and fully integrating these order images into a single panorama view. Mosaicing the images is based on the matching co-ordinate points, their may be chances of getting more than one points. So we have find out best matching co-ordinate point among them for erroneous free mosaic.

6. REFERENCES.

[1] "Digital Image Processing"-Rafel C. Gonzalez & Richard E Woods (Pearson Education).

[2] P.R. Wolf. "*Elements of Photogrammetry*". McGraw-Hill, 2 edition,

[3] P. Kolonia. "When more is better". *Popular Photography*,

[4] S.B. Kang. "A survey of image-based rendering techniques". Technical Report CRL 97/4, Digital Equipment Corp. Cambridge Research Lab, Aug 1997.

[5] Inad Aljarrah, Abdullah Al-Amareen, Abdelrahman Idries, Osama Al-Khaleel, "Image Mosaicing Using Binary Edge Detection" Proceedings of the International conference on Computing Technology and Information Management, Dubai, UAE, 2014

[6] Nazmeen B. Boodoo-Jahangeer, Sunilduth Baichoo, "Face Recognition Using Chain Codes", Journal of Signal and Information Processing, 2013, 4, 154-157.