Detection and Classification of Similar Image Features Using Point Matching Approach

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Abstract— This paper presents a point matching technique for detecting the object of interests and thereby obtaining a warped image. Detecting and classification of entities deal with image based surveillance system. The preprocessing step of detecting the features includes segmentation. Based on the pixel values and edges of the image, the features are extracted. Then certain features of the reference image are matched with extracted features. The approach involves shift invariant algorithm for the surfing of features, thereby the similar features are mapped. Then a classifier named Least- Square Support Vector Machine (LS-SVM) is applied for the classification of warped color space images. The work is being carried out using snapshot images of live video through web cam.

Keywords*— Segmentation; LS-SVM Classifier; Point Matching; Warped images.*

I. INTRODUCTION

The Primary target of surveillance system is to detect and track moving entities (e.g. people, vehicles). The surveillance system involves the following three major steps: (a) segmentation of the video sequence to detect the objects of interest (b) extraction of features (e.g. position, motion, and shape) (c) features tracking.

Color image segmentation is a rapidly developing area of digital image processing. Color image segmentation attracts more attention due to the increasing computational potentialities of personal computers and possibility of their usage for color image processing. Nevertheless, this problem remains less investigated than segmentation of grayscale images. There are many application areas for color image segmentation. The known color segmentation approaches are based on monochrome segmentation methods modified for using color information. The major segmentation approaches for monochrome images are histogram thresholding, edge detection, region-based methods, fuzzy techniques, etc. Color images convey much more information than grayscale images. In many pattern recognition and computer vision applications, the additional information provided by color can help the image analysis process and yield better results than approaches using only gray scale information. Hence, color image processing has become increasingly more practical.

II. RELATED WORK

In crisp, the existing works employs the active region detection by background subtraction method. Here, the object of interest is being separated from the dynamic background by the perception of contrast. Then Region matching is employed to define the velocity vector of moving objects. The Region matching was proposed [1] based on identifying the longest, best matching boundary parts of two regions in successive frames, followed by multiple motion fields that serve as a tool to describe objects motion in a scene and to statistically characterize their trajectories. The main characteristic of this method is that the object motion depends on the position in the image. Finally, the motion correspondence algorithm is applied in order to obtain trajectories and its validation. To perform motion correspondence Greedy Optimal Assignment tracker algorithm was employed. The Validation of motion fields was done by EM (Expectation-Maximization) algorithm.

A. PSO Algorithm

Particle Swarm Optimization (PSO) is a kind of evolutionary computational techniques developed by Kennedy and Elberhart. PSO is a simple but powerful search technique that can be applied successfully to a wide variety of optimization problems, including image processing problems such as image segmentation [3]. First, some particles are initialized which are known as initial population and the number of particles chosen are referred as swarm size. Each particles are initialized with initial assumed solutions and then gradually all the particles change their velocities and positions according to their personal best so far and the group or global best in current time as shown in equation 4 and equation 5. The best values (pBest or gBest) are obtained using a function to be optimize (i.e. maximize or minimize) . That function is known as fitness function in swarm intelligence terminologies [2].

PSO steps:

1. Initialize each particle

2. For each particle calculate the fitness value and personal best (pBest).
3. Calculate Global Best = best among all particles.
4. Update new velocity and positions.
5. Repeat 2 to 4 till termination criteria reach.

The graph matching method has been employed to solve point-set correspondence problems that are posed under a mixture modeling. Mixture modeling encompasses model of structural coherence and affine invariant geometrical errors. For this mixture modeling, Expectation-Maximization algorithm (EM algorithm) has been derived [4]. Correlation-based measure computes the matches only by means of intersection of two edges. The challenging tasks in case of correspondence algorithms are that the struggle with shapes that displays variation in parts of an image. Hence a probabilistic approach has been presented that match shapes using independent part transformations, where the parts are learnt during matching on their own. In order to trigger the algorithm towards finding 'perceptually valid' part structures, semi-supervised learning ideas are used. Shapes are represented by unlabeled point sets of varying size. A background component is used to handle occlusion, local dissimilarity and clutter. Hence, unlike many shape matching techniques, this part based probabilistic point matching has been applied to shapes extracted from real images.

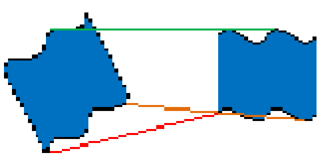

Fig.1. A depiction of graph matching

Shape-based object recognition is a problem in machine vision and content-based image retrieval (CBIR). Over a decade, numerous shape matching algorithms has been proposed [9] that performed well on shape retrieval tests. However, many of these techniques had certain limitations. (1) They operated on shape boundaries and assume that every point on one boundary has a counterpart on the boundary it is being matched to. (2) They had no principle mechanism for handling occlusion, non-boundary points and clutter. (3) They struggle to handle shapes that display significant part-based variations.

The essence of image matching is to determine the structural relationship between the reference image and the matched image. Image matching algorithms can be divided into two categories (1) Gray-based matching and (2) Feature-based matching. The gray-based matching algorithm is very much spontaneous that takes the advantage of the gray scale information. The disadvantage of the algorithm is that it is sensitive to noise and changes in the moving images and its calculation stability is not high. In case of feature-based matching algorithm, the most important steps are the image feature extraction and matching. In addition, the key of extracting and matching is to obtain some feature-points with the higher correct matching rate.

Template matching is conceptually a simple method. We need to match a template to an image where the template is a sub-image that contains the pattern we are trying to find. Accordingly, we centre the template on an image point and count up how many points in the template matched those in the image. Templates are often used to identify printed characters, numbers, and other small, simple objects. Template matching is performed either over bi-level image (black and white) or grey level image depending on the application.

The Robust Point Matching (RPM) algorithm can estimate the correspondence between two point-sets that may be of different sizes. This method uses Deterministic Annealing (DA) for optimization but it has two limitations. First, it does not guarantee the global optimality of the solution. The Coherent Point Drift (CPD) method models point matching and then applies EM algorithm for optimization. But this method has a disadvantage that it cannot guarantee the global optimality of the solution.

Concave Optimization was used to solve the correspondence problems in robust point matching technique. But the techniques that are employed are only suitable for small scale problems [5]. But, in contrast, because of its spatial structure of optimization, the method scales well with problem size. But this method requires that each model point has a counterpart in the data point set that has been overcome in [10]. Such a requirement may not be satisfied when there are outliers in both the point sets.

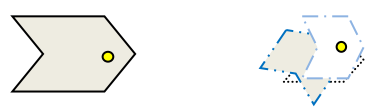

Fig.2. Examples of matching results by RPM

The use of support vector machine (SVM) learning to detect microcalcification (MC) clusters in digital mammograms. SVM is a learning tool originated in modern statistical learning theory. In recent years, SVM learning has found a wide range of real-world applications, including handwritten digit recognition, object recognition, speaker identification, face detection in images and text categorization [8].

A straightforward classification using kernelized SVMs requires evaluating the kernel for a test vector and each of the support vectors has been done. This method outperforms the linear SVM with increase in runtime of evaluation and better classification rate. There is a complexity in modeling the KSVM [7].

III. PROPOSED WORK

This proposed work focuses on detection of similar features between two images and mapping them. These images are the color space extracted from a live video. Here the extracted color space images are matched with the segmented images. Here, in this project, point matching using shift invariant algorithm is implemented for better accuracy in case of color space images. Also Least- Square Support Vector Machine classifier is applied for optimization and comparative analysis.

We first perform capturing of live video and taking an image for segmentation. Then we convert the image into multicolor images. PSO (Particle Swarm Optimization) algorithm is then applied to segment the first level of multicolor images. The objective of applying PSO algorithm is that it works well in multicolour images to identify the reference image. Web Camera is used as the capturing device [11].

PSO-based approaches are proposed to tackle the color image quantization and spectral combining problems. The influence of PSO parameters on the performance of the proposed algorithms is evaluated. In a PSO system, swarms (movement) are considered. The color spacing images are extracted from the captured image. The segmentation algorithm is then applied to certain color spaces like RGB, YCbCr. The major work is confined with mapping the best matching features. Shift invariant algorithm incorporates searching of features for mapping. Hence, Open-Surf function is involved. Then, to obtain a warped image, Warp Function is carried out. The overall block diagram of the proposed work is shown below.

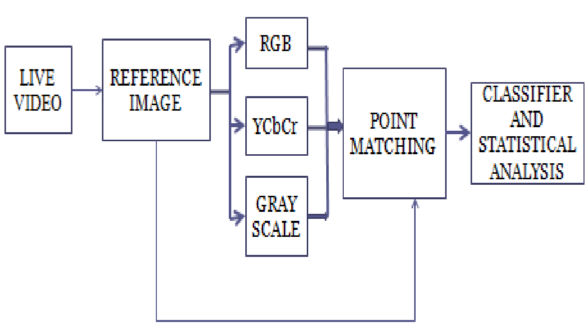

Fig.3. Block diagram of the proposed work

A. *Point Matching*

Point matching approach is being implemented for matching the similar features. Point matching is the task of finding correspondences between two sets of points such that the two sets of points are aligned with each other. A pure point matching approach uses only the location of the points to constrain the problem. But this is a problem in case of broad practical applications, and it has only been well studied when the geometric transformation relating the two point sets is of a relatively low order. Finding the correspondences between two arbitrary point sets is a challenging one with wide spread applications. Shift-invariant approach depicts the idea of wavelet analysis theory, which is an underlying concept of signal analysis techniques.

Here shift invariant algorithm is being implemented. The transformation is done using the affine transform. Affine transformation is a linear mapping method that preserves points, straight lines, and planes. Sets of parallel lines remain parallel after an affine transformation. The affine transformation technique is typically used to correct for geometric distortions or deformations that occur with non-ideal camera angles. For example, satellite imagery uses affine transformations to correct for wide angle lens distortion, panorama stitching, and image registration.

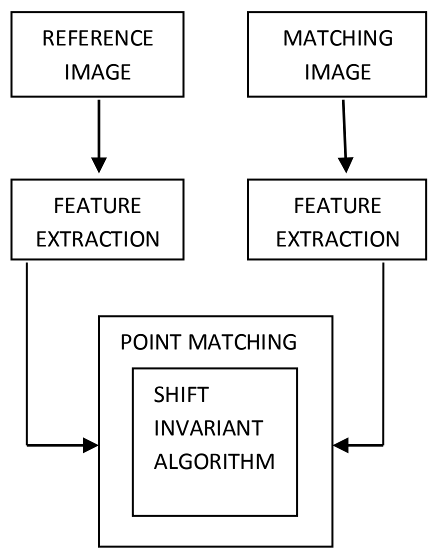

Fig.4. Flow of Point Matching

B. *Classifier*

Classification is one of the most important tasks for different application such as text categorization, tone recognition, image classification, micro-array gene expression, proteins structure predictions, data Classification etc [6]. Most of the existing supervised classification methods are based on traditional statistics, which can provide ideal results when sample size is tending to infinity. In this paper, a novel learning method, Least Square-Support Vector Machine (LS-SVM), is applied.

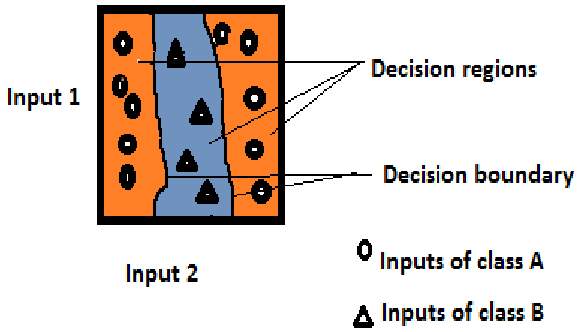

Fig.5. Depiction of classification

The LS-SVM attempts to minimize a bound on the generalization error. As a result, LS-SVM tends to perform well when applied to data outside the training set.

Algorithm for LS-SVM is given below.

1. Given N training data.
2. Choosing a working set with size M (i.e. M support vectors).
3. Randomly select a support vector from the set.
4. Randomly select a point from training data and replace it.
5. Calculate entropy value for the replaced point.
6. Stop if the change in entropy value is small.

Here, we present an initialization of LS-SVM and classified certain parameters of color spaces, also the correlation of matched images. The x and y values are noted down and updated and then the classification graph is plotted.

IV. EXPERIMENTAL RESULTS

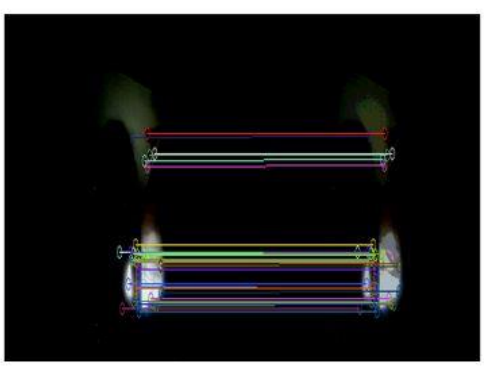

Fig.6. Warped image of RGB

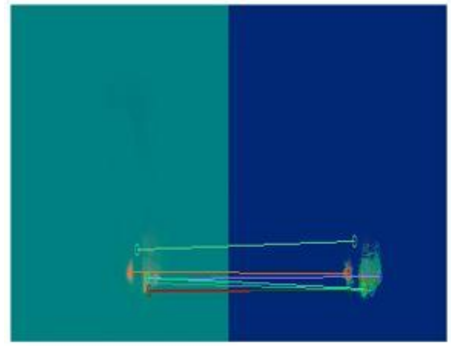

Fig.7. Warped image of YCbCr

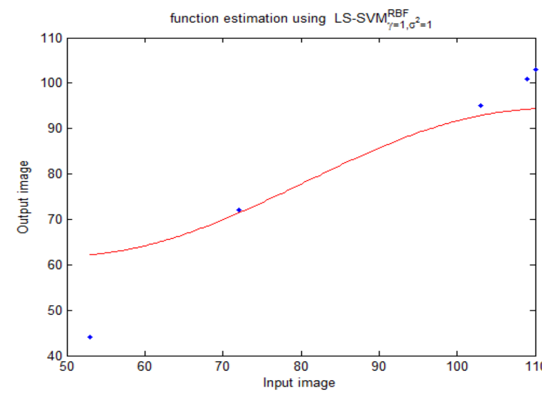

Fig.8. RGB Classification

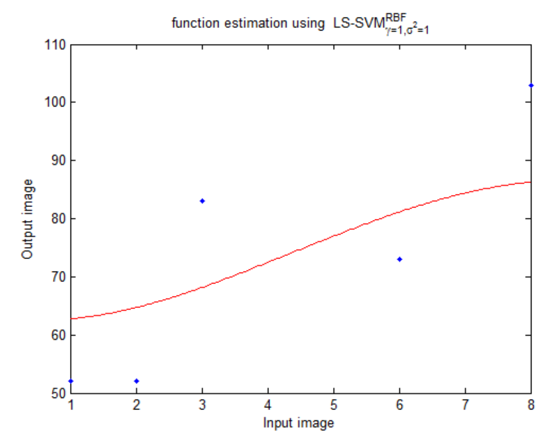

Fig.9. YCbCr Classification

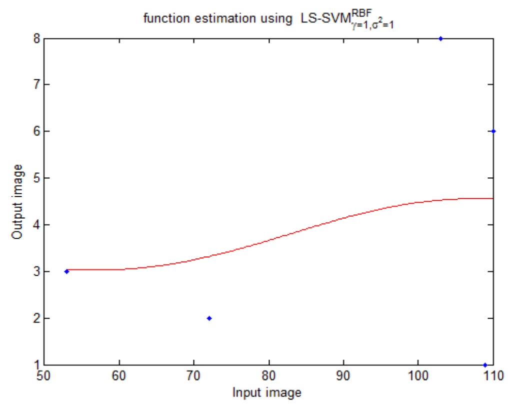

Fig.10. RGB Vs YCbCr

TABLE I- Parametric values of RGB image

	RGB		
CORR1	CORR2	DISTANCE	ERROR RATE
110	103	0.91	0.001
109	101	1.13	0.003
103	95	0.88	0.0033

TABLE II- Parametric values of YCbCr image

	YCbCr		
CORR1	CORR2	DISTANCE	ERROR RATE
6	73	0.98	0.22
1	52	0.9	0.26
8	103	0.88	0.26

TABLE III- Parametric values of Grayscale image

	GRAYSCALE		
CORR1	CORR2	DISTANCE	ERROR RATE
39	125	0.87	0.002
44	131	0.63	0.006
130	298	1.29	0.0066

V. CONCLUSION

The proposed method of point matching using shift-invariant algorithm provides optimized matching accuracy for color spaces. We conclude that the randomly selected pixels in YCbCr are finely distinguished from the decision boundary and the correlation between YCbCr images efficient when compared to other color space. The tables 1 to 3 shows the correlation values between two images and the matching of two images based on distance for the color spaces. From table 1, it is shown that the error rate of RGB image is less in case of RGB. The future work can be carried out with IR image segmentation combined with hybrid point matching approach and implement this work with embedded system for the determination of the object of interest in the captured video. This work can be extended by applying the concept in real-time applications. Thus this project deals with the surveillance image processing which is beneficial for military purposes and several other surveillance purposes.

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REFERENCES

[1] Manya V. Afonso, *Member*, *IEEE*, Jacinto C. Nascimento, "*Automatic Estimation of Multiple Motion Fields From Video Sequences Using a Region Matching Based Approach*", *Member*, *IEEE*, and Jorge S. Marques, IEEE transaction, 2013.

[2] Fahd mohsen, Mohiy Hadhoud, Kamal Mostafa, "*A new image segmentation method based on particle swarm optimization*", The international Arab Journal of Information Technology, 2012.

[3] Fahd M. A. Mohsen,Mohiy M. Hadhoud , Khalid Amin, *"A new Optimization-Based Image Segmentation method By Particle Swarm Optimization*", IJACSA, 2011.

[4] Gerard Sanromà, René Alquézar, Francesc Serratosa,*"A new graph matching method for point-set correspondence using the EM algorithm and Softassign"*, Computer Vision and Image Understanding, 2011.

[5] Wei Lian and Lei Zhang, "*Robust Point Matching Revisited: A Concave Optimization Approach"*, Department of Computer Science, Changzhi University, 2011.

[6] Durgesh K, Srivastava, Lekha Bhambhu, *"Data Classification using Support Vector Machine"*, Journal of Theoretical and Applied Information Technology, 2009.

[7] Subhransu Maji Alexander C. Berg, Jitendra Malik, *"Classification using Intersection Kernel Support Vector Machines is Efficient"*, IEEE transactions, 2009.

[8] Issam El-Naqa, Miles N. Wernick, Nikolas P. Galatsanos and Robert M. Nishikawa, *"A Support Vector Machine Approach for Detection of Microcalcifications"*, IEEE Transactions, Vol.21, 2002.

[9] Meng-meng Zhang, You zhou, *"Point pattern matching by center-based shape context"*, AISS. Vol.5, 2013.

[10] Wei Lian, Department of computer Science, "*Point matching in the presence of outliers in both point sets: A concave optimization approach"*, Changzhi University, 2012.

[11] Dr.S.Mary Joans, Poornima.J, "*An Application of Particle Swarm Optimization Algorithm to Color Space Image Segmentation and its Analysis"*, International Journal for Research in Emerging Science and Technology, Vol.-1, Issue-7, 2015.

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