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Image Matching Using Invariant Local Features

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ABSTRACT: Feature extraction and Image matching are the important task in computer vision. Variations of view and illumination are the challenges in image matching process. There are many methods have been proposed presently in order to address these problems using invariant detectors and descriptors. Then also the matching performance is still unstable and inaccurate. Here propose a method that introduces a view and illumination invariant image-matching. And transform the view of one image to the other, and normalize their illumination for accurate matching. The proposed method is based on SURF based feature extraction.

KEYWORDS: SURF, illumination invariant matching, detector, descriptor matching in video.

I. INTRODUCTION

Image matching method used to find correspondence between two images of the same scene or object in different pose, illumination and environment [1]. Image matching has wide applications like, tracking, image stitching, 3-D reconstruction, simultaneous localization and mapping (SLAM) systems, camera calibration, object classification, recognition, and so on [1]. SURF is a scale and rotation invariant detector and descriptor with better performance. Achieving highly reliable matching results from a pair of images is the task that some of the most popular matching methods are trying to accomplish. Matching task significantly depends on the type of image to be matched and in the variations within an image [5].The challenges of image matching include, stable and invariant feature extraction from varying situations. The existing feature detectors are not invariant to the changes in view and illumination [1].For larger changes, there would be few invariant features can be extracted from both images to be matched [1].The proposed system introduces an iterative image matching method. The proposed view and illumination invariant image matching method aim to improve the accuracy, stability, reliability of matching result. It iteratively estimates the relationship of the relative view and illumination of the image. Transform the view of one image to other and normalize their illumination for accurate matching [1].

II. RELATED WORKS

The process of transforming the input data into the set of features is called feature extraction. There are generally three categories of existing detectors are available. The types are

1. Feature-Based Matching Algorithms
2. Texture based algorithm

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The first method towards digital image recognition was the color-based algorithm [4]. The second attempts towards digital image recognition were limited to the identification of corners and edges. The beginnings of feature detection can be tracked with the work of Harris and Stephen and the later called Harris Corner Detector [4]. The third attempt towards digital image recognition was limited to achieve reliable image matching from textured image with cluttered backgrounds [4]. But the feature-based detectors only perform accurately when the objects to be matched have a same color or a distinguishable corner or edge. To overcome these limitations, a new class of image matching algorithm was developed simultaneously. These algorithms are known as texture-based algorithms [4] because of their capability to match features between different images despite of the presence of textured backgrounds and lack of planar and well-defined edges. One of the first attempts towards this novel approach was undertaken by David Lowe [2]. But the methods of extracting robust features were still very slow [3].

III. PROPOSED IMAGE MATCHING METHOD USING SURF

In image matching, key region is often the local feature due to its stable performance in detection and description [1].

A. Image Matching Steps

Fig.3.1 General Image Matching steps

The region feature based image matching consists of three steps.

1. Detecting stable regions
2. Describing regions
3 .Matching features

In detecting stable region interesting points are extracted from images, and the region of interest is the associated circular region around the interesting point [1]. In describing regions, Color, structure, and texture are widely used to describe images in the recent literature [1]. In matching features, local features from two images are first matched when they are the nearest pair.The proposed algorithm is a simplest transformation algorithm from [1]. The algorithm transforms the view and illumination of the image by estimating the pose and illumination correspondence between the matching pair [1] using an initial detector, e.g., SIFT [2], SURF [3],and then, extract local features from the image and match them with the features in another image [1].

The proposed general image-matching methods is aim to find the transformation matrix between the reference image and the test image. These methods are invariant to rotation, scale, and partially affine changes [1]. Different detectors and descriptors have been developed to extract illumination invariant local features. If we do not normalize the descriptors, they will be sensitive [1] to illumination changes but more distinctive. The proposed method wants to keep both illumination invariant and descriptor distinctiveness [1]. So, it is necessary to estimate the illumination change between the two images.

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Estimating the illumination is a challenging issue when the objects in the images are often accompanied by noise [1]. By using the transformation matrix, it is possible warp the test image to another pose, similar to the reference image.

IV. THE PROPOSED SYSTEM DESIGN

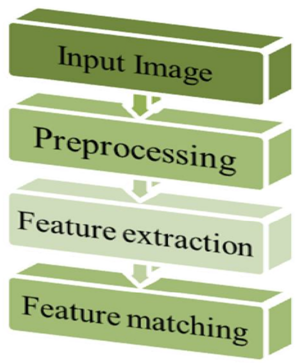

Fig.4.1 Proposed system architecture

Proposed system design includes four main steps. First an input image is preprocessed using some normalization techniques, like histogram localization, DWT (Discrete Wavelet Transform) etc. The next step contains the feature extraction from image by using SURF feature extraction method. The last step is the feature matching.

A. SURF feature detection

Speed-up robust features (SURF) are a scale and in-plane rotation invariant feature [6]. It contains interest point detector and descriptor. The detector locates the interest points in the image, and the descriptor describes the features of the interest points and constructs the feature vectors of the interest points [6].

A. Interest point detection

SURF [6] uses the determinant of the approximate Hessian matrix as the base of the detector. To locate the interest point, it detects blob-like structures at locations where the determinant is at maximum. Integral images are used in Hessian matrix approximation, [6] which reduce computation time drastically.

C.Interest point description

In [6] SURF used the sum of the Haar wavelet responses to describe the feature of an interest point. For the extraction of the descriptor, the first step consists of constructing a square region centered at the interest point and oriented along the orientation decided by the orientation selection method. The region is split up equally into smaller 4×4 square sub-regions [6].

D.SURF feature matching

This proposed method is based on point matching method [6] in order to increase the matching speed and robustness. Because in face recognition, face images are usually upright and normalized [6], the matching points in two images must

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have the similar locations on the two faces. The point-pair with the minimum distance between descriptors will be considered as a [6] candidate matching pair. To verify the validity of the candidate point-pair, the next step is to find out the minimal distance of point-pair, which contains the same point of the probe image, is then searched over the whole area of the gallery image.

V. MATCHING IN VIDEO

An important application of image matching is object detection and poses estimation in video frame [1]. When the camera smoothly moves and the reference image can be matched with the first frame, the estimation of the transformation matrix from the reference image to certain frame in video can be initialized from the matching of the previous frame. In addition, [1] match the first frame with the reference image directly by local-feature-based image-matching method. Here the proposed method directly uses SURF extraction.

A.General Image Matching Method

The purpose of image matching is to compute the transformation between the two points in the parameter space. The method used here includes a reference image and a test image. Reference image is the image that is used as a reference or as the original image. And the test image is the input image that we taken for matching with the corresponding reference image. Here we use a transformation algorithm in order to transform the test image in to an enhanced one similar to test image. In the case of illumination invariance, the first step is to calculate the illumination histogram of the two images in the matched region [1]. In the second step fix one image and calculate histogram translation function from the other image to the fixed one.

VI. EXPERIMENTAL RESULTS

Figure.6.1 Reference image

Fig.6.2 Scaled and rotated image

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Fig.6.3 Resultant matching

A. *Illumination invariant image matching*

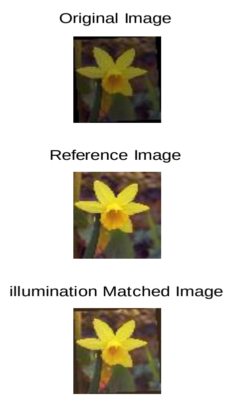

Fig.6.4 Input image

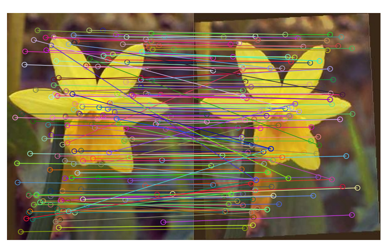

Fig.6.5 Resultant matching

VII. CONCLUSION

There are many feature descriptors and detectors are currently available for feature extraction. Generally image matching consists of three basic steps. They are, Detecting stable regions, Describing regions, Matching features These techniques have some disadvantages like, variation in view and illumination that affects the performance of the matching process. The proposed method is one of the solutions to the specified problem. These methods are invariant to rotation, scale, and illumination changes. The computational cost of our method is very low when compared with the previous methods. It increases the stability and reliability of the original detector.

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