# MULTI-MODE BIOMETRIC DETECTION WITH ACCURACY AND SECURITY

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*Abstract*—**many local features such as speeded Up Robust Features (SURF), SIFT and HARRIS have been widely utilized in image matching due to their notable performances. However, the original SURF algorithm ignores the geometric relationship among SURF features. To overcome this drawback, an improved method combining SURF, SIFT and HARRIS for image matching is proposed in this paper. By combining SURF features into groups and measuring the geometric similarity among features, the discriminative power of the grouped features has been significantly increased. Simulations show that the proposed method outperforms in identification and detection of biometric multimode object accuracy and efficiently.**

## 1. INTRODUCTION

Biometrics has become a vital part of today's life. This is an area of technology which deals with identification of different features of the person like iris, speech, hand prints etc. Verification involves the validation of claimed identification which enrolled these traits and now a days it has become more difficult as number of increased traits. The field of biometrics has received much attention in the last years because it is an interesting alternative to traditional authentication systems like passwords etc. Authentication is required when it is necessary to know if a person is who they claim to be. Sometimes the traits are increased due to enhancement in number of users which affect the database and authentication system's performance. Single biometric based systems are do extremely well as it is very easy and fast system to access the biometric features of a person. For the enhancement of security at this level, combination of different biometrics which is known as multi biometrics is shown in Fig. 1 in which two or more biometrics traits are combined like face and fingerprints or speech and signature, have been current area of research. Multi biometrics integrates different biometrics systems for verification in making a personal identification. This system has advantages to the capabilities of each individual biometrics. Identificationis defined by the one-to-many process of matching submitted biometric data against all other Biometric reference templates to determine whether it matches any of the templates and to determine the identity of the enrolled whose template matches the biometric data. Verification is defined by the process of matching by comparing a given biometric data which is not stored in a database with the biometric reference template (stored in a database) of a single person whose identity is being checked to determine whether it matches the enrolled template. For example on a computer system, a unique verification token with direct correspondence to each username is intended to verify the identity of a justifiable user. All unimodal biometric systems can be used with combination of other to form a biometric.

Fingerprint Geometry. The fingerprint matcher compares data from the input search print against all appropriate records in the database to determine if a probable match exists. Minutia relationships, one to another are compared. Not as locations within an X-Y co-ordinate framework, but as linked relationships within a global context


**Figure 1: Model of Multi-mode object Identification**

Harris corner detector is just an interest point detection algorithm. All that is given to you are the locations of interesting points in the image. SURF is both a detection and **description** framework, where not only do you get interest points, but you also get a good robust description of each interest point that you can use to perform matching between other interest points in other images. Therefore, if you wanted to combine both Harris and SURF together, that isn't possible because Harris does not support describing interest points

Image registration essentially consists of the following steps [2]:

1) Feature detection: It detects the salient and distinctive objects in both reference and sensed images, such as closed-boundary regions, edges, contours, line intersections, and comers.

2) Feature matching: The correspondence between the features in the reference and sensed images is established.

3) Transform model estimation: The type and parameters of the so-called mapping functions and aligning the sensed image with the reference image are estimated.

4) Image resampling and transformation: The sensed images are transformed by means of the mapping functions.

## 2. FEATURE EXTRACTION ALGHORITHMS

We will discuss the Harris corner detector, Harris corner detector, GoodFeaturesToTrack detector, Harris corner detector. In addition, we will introduce SIFT, SURF, FAST, and ORB techniques.

### A. Harris corner Detector

Harris corner detection is a point feature extracting algorithm based on Moravec algorithm based by C. Harris and M.J Stephens in 1988 [6].
Harris corner detector detects the corner point. The point where the average intensity hardily high changes as compared to the previous one direction is called as 'Corner'.
The basic mathematical formula is as follows [2]:

$$S(x, y) = \sum_u \sum_v w(u,v)\,(I(u+x, v+y) - I(u,v))^2$$ ............................... equation (1)

$$A = \sum_u \sum_v w(u,v) \begin{bmatrix} I_x^2 & I_x I_y \\ I_x I_y & I_y^2 \end{bmatrix}$$ .................(2)

$$= \begin{bmatrix} \langle I_x^2 \rangle & \langle I_x I_y \rangle \\ \langle I_x I_y \rangle & \langle I_y^2 \rangle \end{bmatrix}$$ ..................(3)

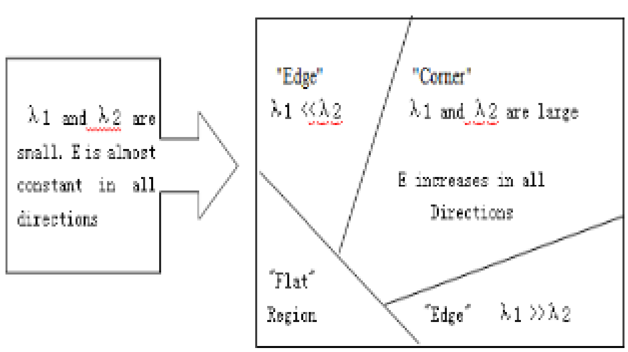

**Figure2 Harris Corner Detector [13]**

Here find out the Eigen values for an interest point [2].
1. If λ1 ˜ 0 and λ ˜ 0 then this pixel (x, *y*) has no feature interest.
2. If λ1 ˜ 0 and λ2 has some large positive value, then an edge is detected.
**3.** If λ1 and λ2 have large positive values, then corner is found.

### B. SIFT Detector

Scale Invariant Feature Transform termed as SIFT is used to identify locations and scales that can be repeatedly assigned under different views of the same object [2]. SIFT has four computational phases which includes: Scale-space construction, Scale-space extrema detection, key-point localization, orientation assignment and defining key-point descriptors [6].

The first stage used difference-of-Gaussian (DOG) function to identify potential interest points, which were invariant to scale and orientation. DOG was used instead of Gaussian to improve the computation speed [7].

$$D(x,y,\sigma) = \left(G(x,y,k\sigma) \quad G(x,y,\sigma)\right) * I(x,y) \qquad \text{........................(4)}$$

$$= L(x,y,k\sigma) \quad L(x,y,\sigma) \qquad \text{.......................................(5)}$$

Where * is the convolution operator, G(x, y) is a variable scale Gaussian, I(x, y) is the input image D(x, y) is Difference of Gaussians with scale k times. A 2X2 Hessian matrix computed at the location and scale of the key point is [2]:

$$\frac{Tr(H)^2}{Det\ (H)} > 10 \qquad \text{…………………………………..(6)}$$

And then rejecting the key points for which,

### C. SURF

SURF uses three feature detection steps namely; detection, description, and matching. SURF speeded-up the SIFT's detection process by keeping in view of the quality of the detected points [1].
SURF selects the angle by calculating the angle and size of every pixel after Gaussian Blur in the local image, and then vote to elect the most angles in all pixels as the main direction.

SURF (Speed up Robust Features) algorithm, is base on multi-scale space theory and the feature detector is based on Hessian matrix. Since Hessian matrix has good performance and accuracy. In image I, x = (x, y) is the given point, the Hessian matrix H(x, σ) in x at scale σ, it can be define as [12]

$$\mathbf{H(x, \sigma)} = \begin{bmatrix} L_{xx}(x,\sigma) & L_{xy}(x,\sigma) \\ L_{yx}(x,\sigma) & L_{yy}(x,\sigma) \end{bmatrix}$$

……..(7)…….

Where Lxx (x, σ) is the convolution result of the second order derivative of Gaussian filter $\partial 2/\ \partial x 2\ (\sigma)$ with the image I in point x, and similarly for Lxy(x, σ) and Lyy (x, σ).

$$H = \begin{bmatrix} D_{xx} & D_{xy} \\ D_{xy} & D_{yy} \end{bmatrix}$$

……………………………………….(8)

**RECENT WORK**

Image Mosacing is the feature base techniques is use in the different active research are in computer vision. This section survey of the previous feature extraction techniques. A literature review had been carried out for the feature based methods that are used in the process of image mosaicing.

RupaliChandratre, VrishaliChakkarwar [4] presented image mosaicing algorithm where they have used Harris corner detector use to detect the corner point that is feature points. RANSAC algorithm use to choose the closest match between the two image by separating inliers and outliers. And then apply the homography estimation taking the inliers and 3*3 matrix use and then finally warped the two images into one to another image. Combining the Harris and RANSAC together, the 2D image stitching becomes the powerful and robust tool to make the Image Panorama [4].

Hemlata Joshi, Mr.KhomLalSinha [8] presented the image mosacing algorithm Harris and SIFT and compare the Harris and sift algorithms. Harris algorithm detects more features and is only rotationally invariant. SIFT is the both rotationally and scale invariant. The performance evaluation of proposed technique is done in terms of PSNR (peak signal-to-noise ratio), MI (Mutual Information), NAE (Normalized Absolute Error), FSIM (Feature similarity index measure), SSIM (Structural similarity index measure), and EME (Enhancement performance measure). The comparative study shows superior results for SIFT as compared to Harris and algorithm [8].

Mahesh, Subramanyam M. Y [9] is the performance of various feature point detectors in extracting feature points. Image mosacing algorithm using steerable Harris corner detector and the RANSAC algorithm apply to remove the mismatch outlier and find out the best line and Harris and compare the Harris and SUSAN corner detector. SUSAN detector a circular mask is applied around every pixel. Random Sampling Consensus (RANSAC) is an algorithm to fit a model to the data set while classifying the data as inliers and outliers. This algorithm has been applied in estimating the fundamental matrix to match two images with wide or short baseline and estimating a homography [9].

Jiaxi Wang and JunzoWatada [3] presented by the image mosacing using SURF algorithm is use in feature detection. The camera is moving, transformation becomes necessary in stitching and to get the transformation matrix of two images, corner points are detected first, and then do the comparing so that some pairs of corresponding points can be found and finally we use their coordinates to get the transformation matrix [3].

## II. PROBLEM FORMULATION

1. The problem with the correlation based algorithm is that the image taken to identify is similar to that of data base that is already stored in system. If we change some features of the image i. e colours, light or intensity etc. then this algorithm fails. For example if the pixel of the image is enlarged then the data base can't match the image and we get invalid match results.

2. So to solve this problem multi-mode object detection and matching are proposed with the integration of SURF, HARRIS and SIFT features are used. These features can match each and every feature of the image .Data base image that may be any text image or fingerprint image will

select different-different random pixel points with respect to the selected image (thumb or fingers). So in this present work ,the problem formulation is to perform various mathematical calculation in a parallel manner such that we get many blobs for one image using different features such as SURF, HARRIS and SIFT so that we can get best results of FRR and FAR.

**III. DATA ANALYSIS** The various parameters related to an image which can be calculated and used to describe the details of an image before processing and after processing can be listed as:

1. Blobs calculation
2. Location of the points
3. Scale
4. metric
5. Sign of laplacian
6. Orientation

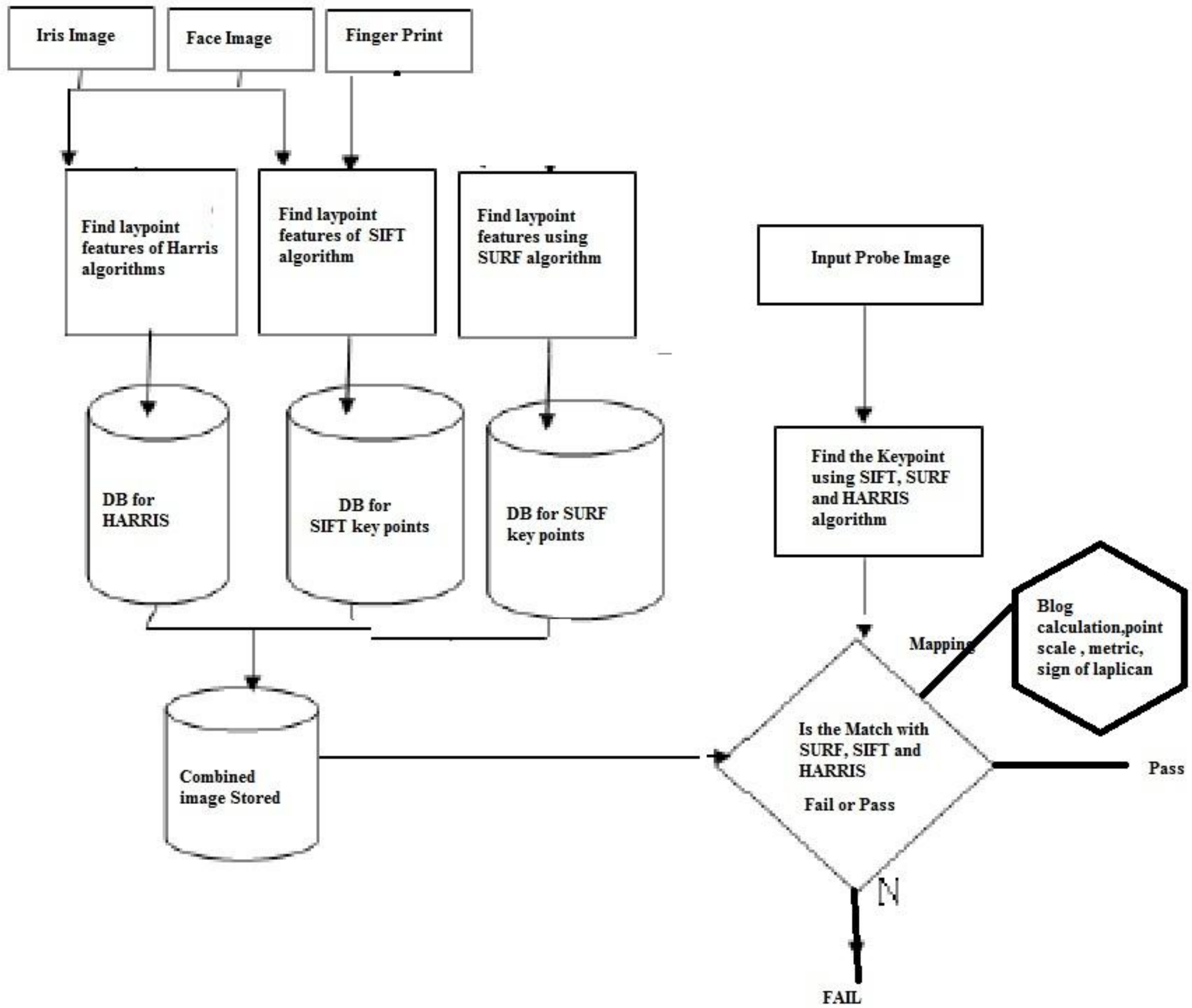


Figure 3 : Flow chart for Multi-model Detection and identification of Biomarkers in Security System

## Harris Corner Detection Algorithm

1. Compute x and y derivatives of image

$I_x = G_\sigma^x * I \quad I_y = G_\sigma^y * I$

2. Compute products of derivatives at every pixel

$I_{x2} = I_x . I_x \quad I_{y2} = I_y . I_y I_{xy} = I_x . I_y$

3. Compute the sums of the products of derivatives at each pixel

$S_{x2} = G_{\sigma 1} * I_{x2}$ $S_{y2} = G_{\sigma 1} * I_{y2}$ $S_{xy} = G_{\sigma 1} * I_{xy}$

4. Define at each pixel(x,y) the matrix

$$H(x,y) = \begin{bmatrix} S_{x2}(x,y) & S_{xy}(x,y) \\ S_{xy}(x,y) & S_{y2}(x,y) \end{bmatrix}$$

5. Compute the response of the detector at each pixel

   $R = Det(H) - K(Trace(H))^2$

6. Threshold on value of R. Compute Non max supression

## Results and Discussion

### IV. SIMULATION STUDIES

In this section, the feature-based image matching performance of the proposed approach is compared with the original SURF-MESR algorithm. The images used in the simulations include the face, IRIS and Finger Print from the standard test images provided and the images obtained by rotating the image 10 to 80 degrees. The sizes of these images are all 850×680 pixels.

The percentage of correct matches and repeatability are used for evaluation measurements. Correct match ratio c(P) is defined as the ratio of correct matches ( CM T ) to total matches. The repeatability score is computed as a ratio between the number of point-to-point correspondences that can be established for detected points and the mean number of points detected in two images

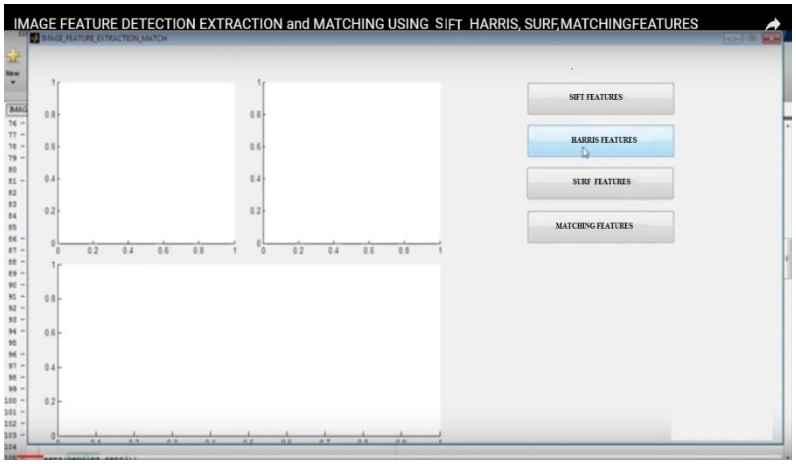


Figure 4 . MENU OF MULTI-MODEL OBJECT DETECTION

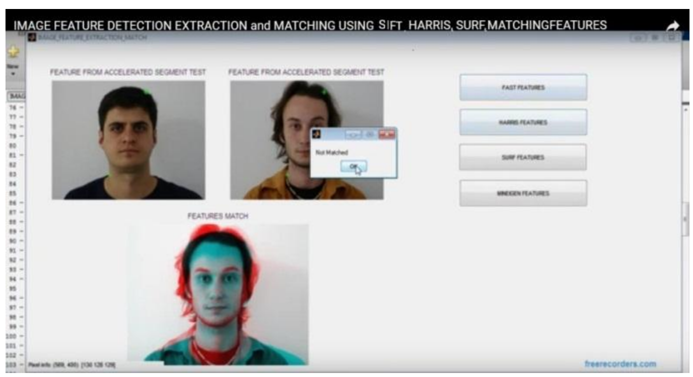


Figure 5: Harris corner detection for Face Identification Miss Match


Figure 6 : Detection of Harris Corner for Face Identification

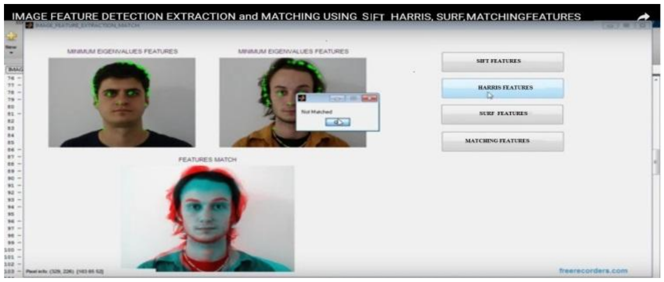


Figure 7. SURF METHOD FOR FACE MATCHING MISS MATCH


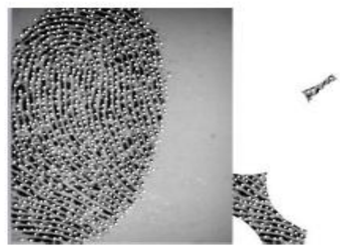

Figure 8: FingerPrint Image Figure 9 and10 : Harris Point Edge Detection and SURFend point detection

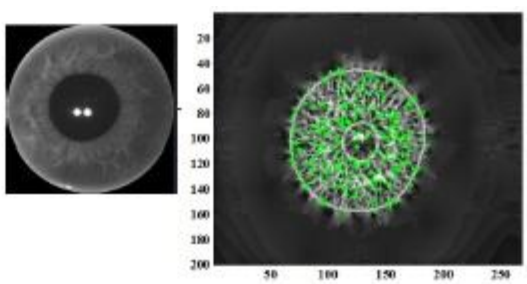


Figure 11 : Harris keypoint Detection

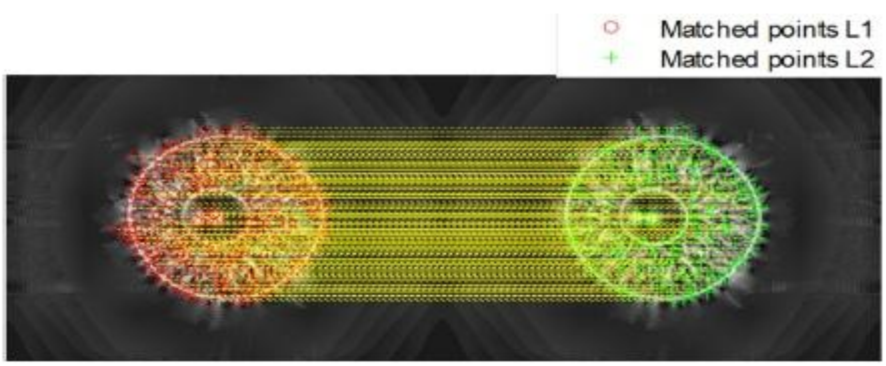

Figure 12 : SURF Edge Detection of IRIS

TABLE 1 – COMPARISON OF MATCHES OF SURF-MSER AND FIST-HARRIS-SURF

| ALGORITHM | $M_1$ | $M_2$ | $C(I_1,I_2)$ | $R_{12}$ | $T_{cm}$ | $P_c$ |
|---|---|---|---|---|---|---|
| SURF-MESR | 179 | 154 | 97 | 0.5778 | 88 | 0.867 |
| SIFT-HARRIS-SURF | 137 | 76 | 64 | 0.59 | 61 | 0.9946 |

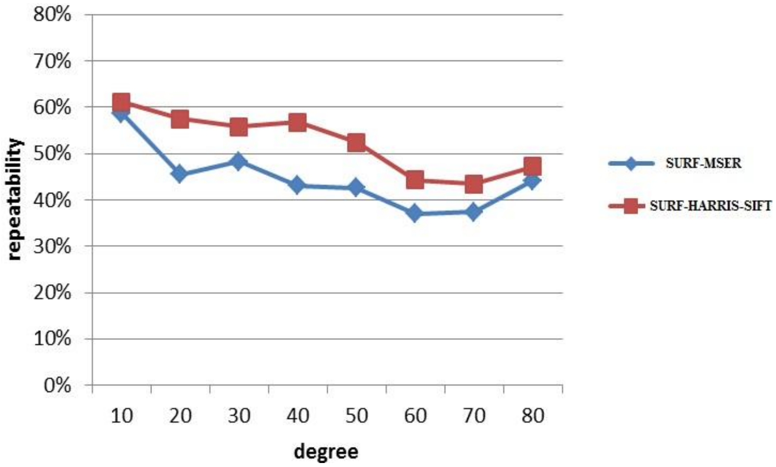


Figure 13: Comparative graph shown the existing with the proposed

The developed algorithm was tested over a range of test sets, belonging to different persons from the taken data base:- 1. FAR is proved 0 with the three algorithms and FRR is 1 with the same i.e. SURF, HARRIS and SIFT

**TABLE 2.CALCULATION OF FRR AND FAR WITH EXISTING AND PROPOSED**

| DATASETS | SURF | | SIFT | | HARRIS | | SURF-SIFT-HARRIS | |
|---|---|---|---|---|---|---|---|---|
| | FRR | FAR | FRR | FAR | FRR | FAR | FRR | FAR |
| DB1 | 53.58 | 0 | 89.3 | 1.7 | 23.07 | 0 | 1 | 0 |
| DB2 | 51.08 | 0 | 87.6 | 3.7 | 7.85 | 0 | 1 | 0 |
| DB3 | 73.75 | 0 | 91.2 | 2.4 | 5.51 | 0 | 1 | 0 |
| DB4 | 65.24 | 0.015 | 81.3 | 0.9 | 7.47 | 0 | 1 | 0 |

2. Simultaneous mathematical calculations performed in parallel using SURF, HARRIS and MSER to ensure that the identified image is the same as all three algorithms give same identified image.

3. Better combined results are shown with combined features.

Then a quantitative comparison on the entire set of images is done and some results are presented I The results of the simulation show that the proposed approach increases correct match ratio and repeatability score for SURF-MESH , thus we can conclude that the proposed approach works better. One reason for this is that SURF-MSER excludes a number of SURF points which only contain few information of the image. Another reason is that the matching rule in the proposed approach measures the geometric similarity among the feature points which reduces the error matching and makes our approach more stable to rotation.

## Conclusion

A biometric identification system for the identification of a person based on combined algorithms has been developed which identifies a person via different feature extractions and condition based algorithm along with adding a high level security using SURF, MSER and HARRIS.

In this paper, a combination method based on SURF-SIFT-HARRIS is proposed. The original SURF-MSER algorithm ignores the geometric relationship among features in image matching. The proposed approach integrates SURF-SIFT-HARRIS features and geometric properties of an image to find correct matches by combining SURF ,SIFT with HARRIS under an effective matching rule. Meanwhile, simulation results show that the proposed method outperforms SURF-MSER both in correct match ratio and repeatability

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