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An Efficient Approach for Identification of Copy- Move Image Forgery using SURF and SIFT based Techniques

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***Abstract*—Internet has changed the world of computers and how we use them. Now there is no field left that may not require internet. It has impacted mostly the fields like image processing, machine learning, cyber security, data mining etc. Technological developments today have made the life so comfortable and easy but also put forward a challenge of authentication of digital data generated from various domains. This has become a major concern for security. To address this concern, we are encapsulating facet point juxtaposition, adaptive over dissection for forgery identification in our proposal. We have based our work on Key point and Section based forgery identification techniques. Adaptive non-intersecting, irregular sections are utilized to uncover suspicious sections in the images. Dissection algorithms are used to assist in this process. Facet points are mined by comparing and juxtaposition each section with its facets. Super pixels are used instead of facet points in the proposed forgery section mining system. The neighbouring sections are melded into facet sections to acquire merged sections which have similar color facets. To end the process morphological operations are used over merged sections to obtain forgery section. The outcomes obtained shows that this proposed algorithm can achieve superior and accurate outcomes even in most critical constraints when compared to other existing approaches.**

***Index Terms*— Image Processing, Forgery Identification, Image Forgery, Juxtaposition, Digital Images.**

I. INTRODUCTION

Digital image processing in this modern era has become one of the most protruding domains for research in multidisciplinary fields. The core of electromagnetic spectrum and security is constituted by digital image processing. It has become the primary focus of research with huge scope to safeguard privacy and maintain confidentiality. Achieving the desired outcomes in image processing remains a challenging task that needs an apt solution. Digital images are primary source for forensics, deep learning, AI and thrust areas. Using deep learning techniques today, we can fake eminent personalities thus by posing challenge to forensics to detect forgery images. The disparity between forgery and original image has been narrowed done deeply that it's almost becoming impractical to identify the difference. This drawback is addressed by proposed work [1].
Image forgery has become very common today in social networks. Copy-move forgery is among well-known digital image manipulation practices today that copies portion of the image and is bonded at a different location

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on the that image. In our literature survey we found that there are so many copy-move forgeries identification techniques developed. Fridrich et al. demonstrated how dissection of input image into rectangular sections is done to determine the forgery sections utilizing Discrete Cosine Transform [2]. Luo et al. demonstrated usage of RGB color components and discrete data in this approach [3]. Li et al. proposed to use Discrete Wavelet Transform and Singular Value Decomposition for mining image facets [4]. Mahdian and Saic work showed us facet mining utilizing more than 20 blur-invariant points [5]. Fourier-Mellin Transform was utilized for mining facets and transformation by Bayyam et al [6]. Wang et al. proposed utilization of mean intensity using dissimilar radii for mining of section facets [7]. Zernike moments were part of Ryu et al work to get section facets [8]. Data Entropy was utilized by Ravo Solorio and Nandi to acquire section facets [9]. Scale Invariant Facet Transform technique was employed by I. Amerini and L. Ballan to acquire section facets [10].
Two process already exist for forgery identification namely Section and Key point based. The first approach utilizes input image by dividing into regular section, intersecting section and its counterparts by means of the image pixels for acquiring forgery sections else processing is done using transform. The later Key point-based forgery identification technique employs duplicate section identification. These approaches exhibit few drawbacks: one is high complexity involved in partition of image into overlapped sections, secondly complexity in forgery section geometrical transformation and thirdly low recall rate incurred due to partition of host image into regular sections.
A dominant approach was needed to address the drawbacks exhibited. Thus, we propose a unique copy-move forgery identification technique that encapsulates adaptive over-dissection and facet juxtaposition. Proposed technique adaptively partitions the host image into irregular and non-intersecting number of sections. Facet point mining is then carried out on each section and compared with others to obtain similar facet points which will assist in determining suspicious forgery sections. Identical facet points are exposed to morphological operations to acquire the forgery sections.

II. Digital Image Forgery

Morphed images are logjam in today's digital world. It is very often seen that these images are used primarily in scandals to create polemics. News agencies, political propaganda and defaming are a boom relying on forgery images for their personal gains causing disruption to harmony in the society. Thus, it is very essential to devise approaches for authentication and credibility of images to counter such practices.

Figure 2.1 Image retouching (left: original image, right: altered image)

Figure 2.2 Image Splicing

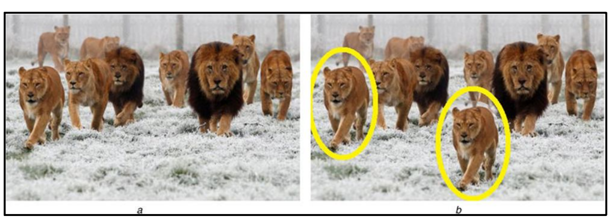

Figure 2.3 Copy-Move Forgery

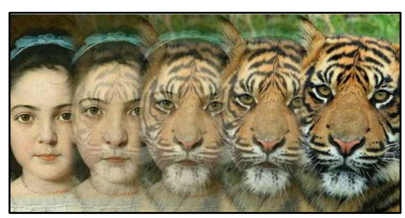

Figure 2.4 Morphing Image

The vital forgery techniques are classified into four types:
1. Image retouching: This involves enhancing an image or altering certain facets to make the image attractive to the eyes of a reader. There are a plenty of tools like adobe photoshop that makes this task simple and look natural.
2. Image Splicing: This process involves copy and pasting of parts of sections from the same source or a different image. This is the primary step of an artistic collage creation.

3. Copy-Move (cloning): This process involves copying and pasting a section from an image to other location within the same image.
4. Morphing: This technique interpolates among two images to have a blend of two input images.

III. Existing Approaches

A. Identifying Duplicated Image

Alin C Popescu et al. presented an approach which successfully come across and localize duplicated sections in an image. This approach works by way of first applying a foremost element analysis on small, fixed dimension image sections to yield a discounted dimension illustration. This representation is strong to minor variations inside the photograph because of colorant clatter or lossy compression. Replicated sections are then identified by way of lexicographically categorization of entire image wedges [11].

B. Fast Copy-Move Forgery Identification

Hwei-Jen Lin1 et al. offered a fast copy-move forgery approach. This technique works by partitioning the source image into chunks of same dimension. Facets are then mined and stored in a sorted vector. Then shift vector is computed and evaluated. A section with all facet vectors like shift vector is taken and medium cleaning and connected component assessment is accomplished to get the outcome [12].

C. Robust Copy-move Forgery

Yan jun Cao et al. Presented an approach to detect such unique object. To begin, the unique image is separated into fixed-range sections, and discrete cosine rework (DCT) is implemented to each section, thus, the DCT coefficients form each section. Secondly, each cosine altered section is exemplified by a circle section and 4 characteristics are obtained to ease the measurement of each section. Eventually, the specific vectors are lexicographically taken care of, and duplicated photo sections will be tallied with the aid of a preset threshold price [13].

D. Identification of Digital Images Using SURF

B. L. Shivakumar et al. showed an automated and robust reproduction-circulate forgery identification technique based totally on surf, which detects duplication location with distinctive length. Experimental outcome illustrates that the recommended technique can come across copy-move forgery with minimal fake suit intended for images with high decision. However, a little insignificant, copied areas had been not efficaciously identified. As a part of our future paintings, we will keep having a look at replica-move forgery to become aware of tampered section boundary and reduce the fake fit charge [14].

E. Sift-based Forensic Process

Irene Amerini et al. stated the challenge of identifying if an image has been forgery is explored; This work focused specifically, how the image is duplicated after which inserted onto any other quarter to produce a replication or to abandon that is awkward. Usually, A geometrical conversion is needed to confirm replicated image on the new image. to conform the photograph patch to the brand-new context a geometrical transformation is wanted. To strike through such transformation, a distinctive procedure predominantly built on scale invariant facets transform (sift) is recommended. Like approaches permits us understand if a duplicate-pass incident has passed off. moreover, to salvage the geometric transformation employed to take out cloning. Considerable tentative outcomes are provided to substantiate that the approach can specifically individuate the revised location and, similarly, to assess the geometric conversion boundaries with excessive consistency [15].

IV. Proposed Process

Forgery identification has gained importance over a period with increase in the no of daily forgery cases online. The Proposed system achieves efficiency utilizing adaptive over dissection algorithm and the facet point juxtaposition techniques which is demonstrated in the figure 4.1 and is defined as below:

A. First step involves splitting of the source image into un-equal and non-intersecting sections by treating them with over dissection technique. The resultant sections are termed Image Sections (IS).
B. To extricate the section facets (SF) in a reliable manner, asymmetrical section dissection is utilized then Scale Invariant Facet Transform (SIFT) technique is applied, where it is utilized to each dissected section.
C. Another vital parameter in the proposed study is the suspected forgery sections, which is acquired by carrying out the juxtaposition between the BF with every section and the accorded facet points are labeled as

the Labeled Facet Points (LFP) which is beyond utilized as allusion for forgery identification. Ultimately, we recommend the Forgery Section Mining process to expose the forgery area in the source image corresponding to the mined LFP.

A. Adaptive over dissection

The adaptive over dissection exhibits complexity as dimension of the host images upsurges, resulting in expensive evaluation of the intersecting sections. This is overcome in our approach utilizing the adaptive over dissection technique, that can dissect when the host image is converted to non-intersecting areas of irregular shape as image sections, the forgery areas can be identified by juxtaposing these non-intersecting and irregular areas. In Dissection, the non-intersecting dissection eases the evaluation effort equated to the intersecting sectioning. In Addition, the erratic and profound sections better embody the forgery section in contrast of regular sections. Nevertheless, preliminary dimension of the super pixels in SLIC is challenging toward ascertain. The host image in real world is different in dimension and semantics which are utilized for identification of forgery. With our forgery identification process, distinct preliminary super-pixel dimensions can produce different forgery identification outcomes. As A Result, distinct host images ought to be sectioned in super-pixels of distinct primary dimensions, that are mostly part of the forgery identification process.

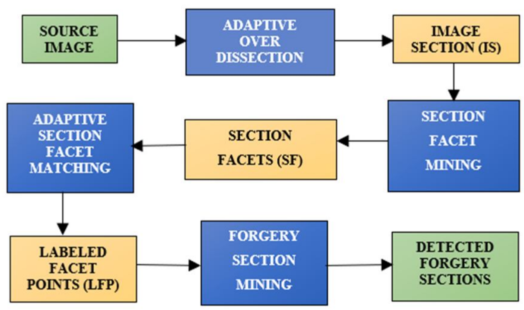

Figure 4.1 The copy-move forgery identification proposed scheme

We planned and organized many experiments to inspect the correlation amongst occurrence dissemination and the preliminary dimension of the super-pixels to acquire apt forgery identification outcomes. Then four-step DWT is performed utilizing Haar wavelet employed over current image. Minimal occurrence energy ELD, elevated occurrence energy EHD can be calculated using the formula given below. With the outcome of 1 and 2, one can determine the proportion of the low energy distribution PLD using (3), after which the preliminary dimension S of the super-pixels can be evaluated as in (4)

$$E_{LD} = \sum |CA_4| \qquad (1)$$

$$E_{HD} = \sum_i \left(\sum |CD_i| + \sum |CH_i| + \sum |CV_i| \right), i = 1,2, \dots ,4 \qquad (2)$$

$$P_{LD} = \frac{E_{LD}}{E_{LD} + E_{HD}} . 100\% \qquad (3)$$

$$S = \begin{cases} \sqrt{0.02 \times M \times N} P_{LD} > 50\% \\ \sqrt{0.01 \times M \times N} P_{LD} \leq 50\% \end{cases} \qquad (4)$$

In the above, S is preliminary dimension of the super-pixels; (M ∗ N) implies dimension of the selected image; and PLD is proportion of the minimal occurrence distribution.
The alteration process can dissect the image into sections as well as the preliminary dimension as a provided image dimension, which can be defined by each photo to be the first apt dimension to maximize the negative search outcomes.

B. Section Facet Mining

We begin with dissection of the host image into sections and attributes of the host image are mined from obtained image sections (IS). When we look at the existing approaches the identification process mines facets of same dimension or precisely utilizes the pixels for image sections. The mined facets provide the knowledge about the content of the IS thereby discarding the location information. The facets are vulnerable to various image transforms. So, in this process the facets are mined from IS which are resistant to various transforms. The facet mining processes SURF, SIFT are employed throughout the entire process. All the image processing operations either it may be scale, blur, compress or rotate, experiments have shown that the outcomes obtained with SIFT are highly coherent and have superior in performance compared to other facet mining process. So, in this work, SURF is utilized for facet point mining. Therefore, each section facet contains irregular section information and the mined SIFT facet points.

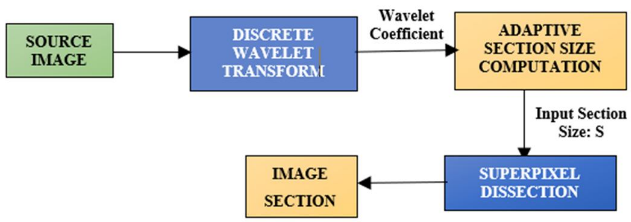

Figure 4.2 The adaptive over-dissection process

C. Section Facet Juxtaposition

In most of juxtaposition techniques, it generates a precise section pair only. An identical vector of shift is obtained if there are many juxtaposition points. Specified ceiling, the paired sections gave shift vector are classed as sections those could been emulated and turned. In this approach, as section function made up of a programmed distinctive set points, we recommended a distinct approach aimed for detecting the matching sections.

Section Facets (SF) are taken as the input for the Section Facet Juxtaposition. All the SF are then loaded, and the correlation coefficient are determined for the IS. Then juxtaposition threshold (JT) value is evaluated based on occurrences of correlation coefficients. Utilizing the obtained JT, we locate the matched sections (MS). The matched facet points are then labelled (LFP) that denotes suspected forgery sections.

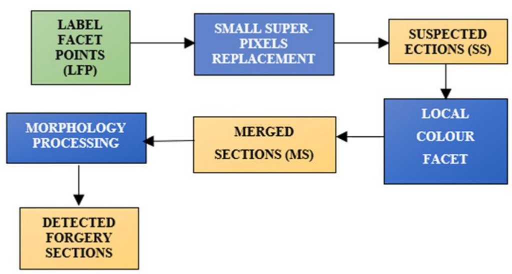

Figure 4.3 Flow chart of the Forgery Section Mining

D. Forgery Section Mining

Once the mining of LFP is done, then it becomes necessary to trace forgery sections. As these mined LFP are just the traces of forgery sections, A spoofing detection and mining process is required and employed to detect forged sections more accurately. To detect the suspicious sections (SS), a process is needed that supplants the LFP with small super-pixels, which is attained by dissecting the host image aptly as minor super-pixels. The indigenous color attributes in super-pixels neighbors of the SS are assessed to enhance exactitude and upturn levels.

When we detect that local color attribute is the one that was suspected neighboring super-pixels are melded into the related suspect sections. Then are put in outcomes as MS. Finally, to produce the identified copy-motion forgery sections, the geomorphologic process is employed to fused section. Figure 4.3 demonstrates the flow of the forgery section mining.

In the process, LFP are loaded and SLIC process is applied over the preliminary dimension S on selected image for dissecting to minor super-pixels termed facet sections. Comparing each LFP with related or similar section results in generating the SS. Next, we gauge the indigenous color facet in super-pixels which are adjacent at SS, termed as Adjacent Sections (AS) and blend the AS into resultant SS to obtain the merged section. Morphological clone identification process is applied into merged section to conclusively obtain the identified forgery sections [16].

V. Experimental Outcomes

Precision, Recall, F score and Processing Time are the four parameters we selected measure the performance [17]. Precision is the likelihood that the identified sections are pertinent and is classified as the ratio of the amount of precisely identified forgery pixels to number of totally identified forgery pixels. Recall is likelihood of appropriate sections are identified, and it is defined as the ratio of the number of correctly identified forgery pixels to the number of forgery pixels in the ground-truth forgery image. F0.5 score is utilized as a allusion factor to determine the forgery identification outcome; the score relates together the precision and recall as single rate, and it can be determined utilizing

$$F0.5 = 1 + 0.5^2 * \frac{Precision * Recall}{0.5^2 * Precision + Recall}$$

TABLE 5.1 Forgery Identification Outcomes of Proposed Adaptive Over-Dissection process with SIFT and SURF

IMAGES(PNG)	PRECISION		RECALL		F Score		TIME	
	SIFT	SURF	IFT	URF	IFT	URF	IFT	JRF
BRICKS (3888*2592 pixels)	0.92	0.967	.899	.831	.9158	.9364	3.27	.27
EGYPTIAN (3039*2024 pixels)	0.87	0.923	.618	.596	.8109	.8318	4.35	.86
HORSES (3039*2014 pixels)	0.82	0.893	.656	.595	.7878	.8122	2.78	2.8
MYKENE (3872*2592 pixels)	0.81	0.859	.796	0.75	.8101	.8355	9.79	2.9
RED TOWER (3264*2448)	0.93	0.96	.649	.608	.8577	.8604	6.05	.44
BEACHWOOD (3264*2448)	0.94	0.982	.511	.486	.807	.8159	9.04	.98
SHIP NUMBER (3264*2448)	0.93	0.959	.821	0.78	.907	.9172	7.79	.89

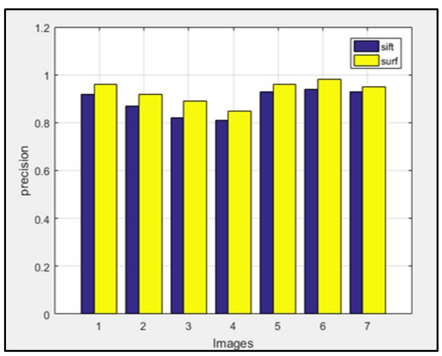

Figure 5.1 Precision

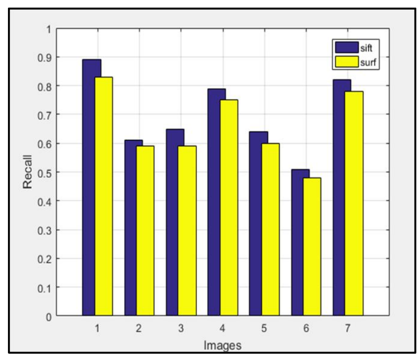

Figure 5.2 Recall

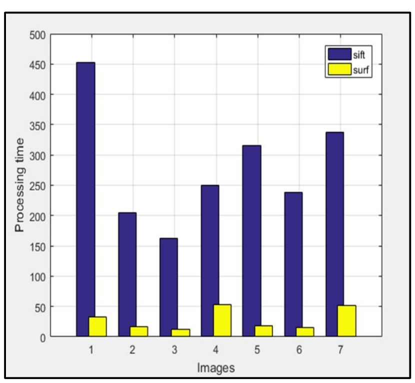

Figure 5.3 Processing Time

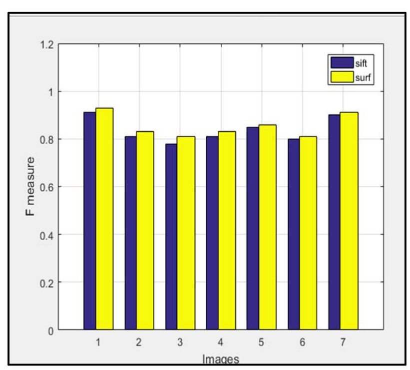

Figure 5.4 F measure

Table 5.1 is depicting evaluation outcomes of forgery identification utiliing recommended Over-Dissection with two different key point-based process SIFT and SURF. Now we may certainly perceive that for selected IS, the proposed Over-dissection process with SURF may yield much precise forgery identification outcomes thru elevated Precision=96.7% than Precision=92% OF SIFT and, at the same time gives a much lower

Recall=83.15% than 89.98%, higher F measure=93.648 than F=91.859% and remarkable low processing time of 33.278 sec than by 453.279 sec by using SIFT process. The outcomes indicate that the proposed algorithm with SURF shows good forgery identification outcomes and remarkably low processing time.

Precision outcomes of proposed process using SURF (indicated by Yellow Color) can be viewed in Figure 5.1 which also shows the comparison along existing scheme utilizing SIFT (Indicated by Blue Color). The precision of SURF employed process is higher than the later SIFT employed process.

The Outcomes of Recall of the proposed process are compared to existing techniques and performance can be viewed in Figure 5.2. We can say that the recall of proposed process using SURF is superior to exiting SIFT techniques when are exploited under various attacks. The Forgery Section Mining procedure assist significantly diminish the likelihood of the forgery being unidentified and improves the recall at high level.

The processing time of the proposed process using SURF is graphed in comparison to existing approach SIFT and can be viewed in Figure 5.3. We can conclude that processing time of proposed scheme is much lower of the latter case.

F scores that combine precision and recall as one for proposed process using SURF is compared with process using SIFT and the resultant can be viewed in the Figure 5.4. It also shows that proposed process is better than the latter.

A. Identification Outcomes under Different Transforms

The proposed process of forgery detection is not only tested against simple copy / move but with various transforms of attacks. The forged images are obtained using a geometric distortion of dataset. The distortions were scale, rotate, compression, noise reduction and down sampling. To diminish the impact of sample uncertainty, average precision, recovery, F measure, and processing time are calculated on all images in the data set.

1. JPEG compression is applied on the forged images at quality factor contrasting from 100 to 20, in steps of -10. Total of 8×10=80 images for both SIFT and SURF is tested.
2. The copied sections are rotated with the rotation angle contrasting from 2º to 10º is used to rotate the copied section in steps of 2º, Total of 7×5=35 images for both SIFT and SURF is tested.
3. Eight forgery selected images from data set are lowered 90%, 80%, 70% and 50%. Total of 8×4=32 images each for SIFT and SURF are tested.
4. The copied sections are scaled with the scale factor varying from 1.2 to 2, in steps of 2%, In this case, a total of 7×5=35 images each for SIFT and SURF is tested.
5. The forgery images are tested against noise attacks by applying noise with contrasting percentages from 10 to 90 in interval of 20. Total of 7×5=35 images each for SIFT and SURF is tested.

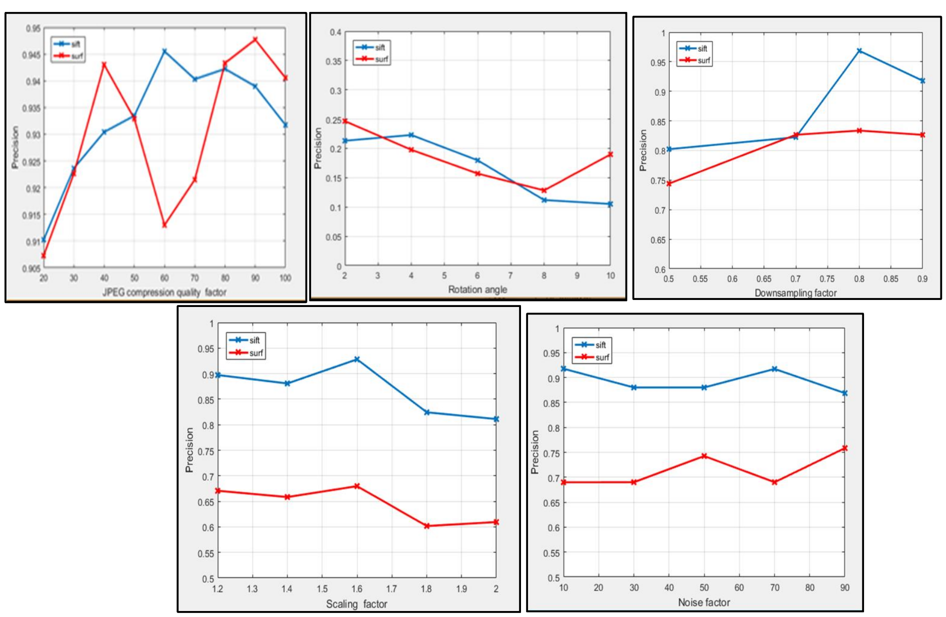

Figure 5.5 Precision outcomes at pixel point

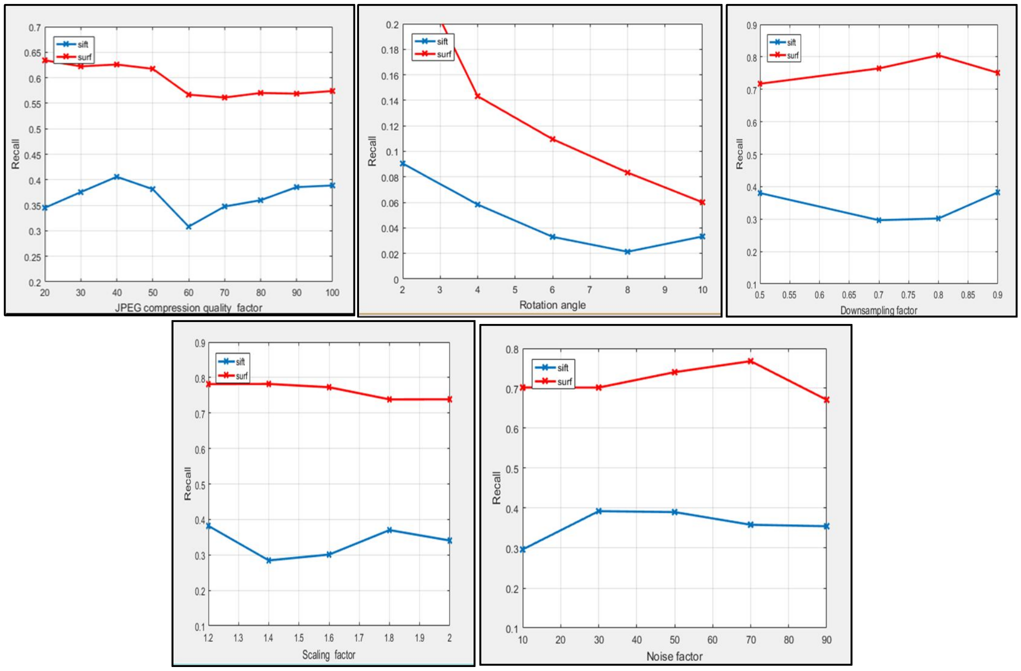

Figure 5.6 Recall outcomes at pixel point

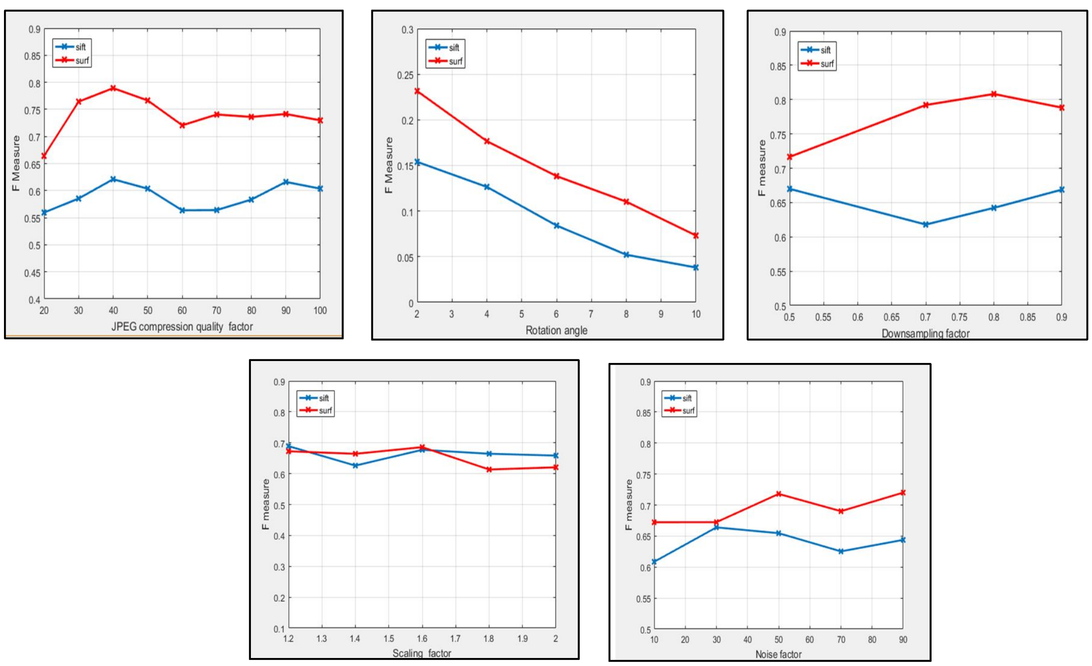

Figure 5.7 F score outcomes at pixel point

The Figures 5.5, 5.6, 5.7 and 5.8 show the identification outcomes at pixel point underneath distinct attacks. The red representation in graph denotes proposed adaptive section dimension dissection utilizing SURF technique and blue representation denotes outcomes using SIFT.

In the Figure 5.5 we compared outcomes of proposed work with existing approaches. We can strongly say that precision of recommended scheme with SURF outstrips that with SIFT.

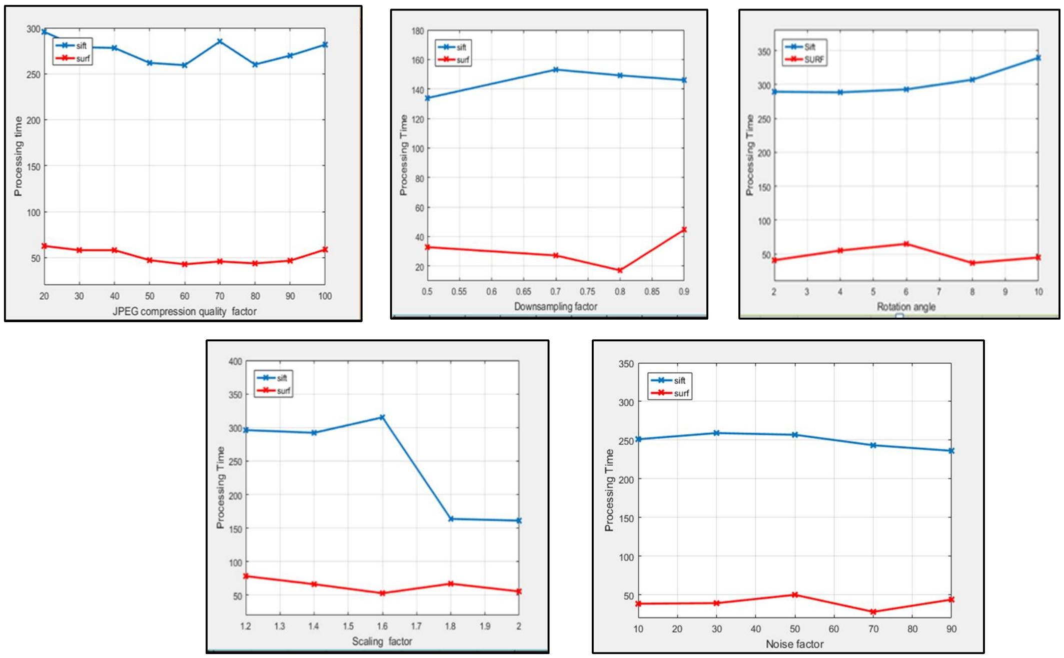

Figure 5.8: Processing Time at pixel point

When we look at the Figure 5.6, recall outcomes of recommended work are significantly nicer than existing approaches when exposed to various attacks.

F Scores in Figure 5.7 amalgamate precision and recall as one value, for recommended work are equated with the present process. We conclude forgery identification outcome of recommended scheme is superior than current approach as exposed to various attacks.

Processing time of proposed work with SURF and SIFT can be observed in Figure 5.8. It is observed that proposed work processing time with SURF is remarkably lower than with SIFT.

VI. CONCLUSION

This work proposes image forgery identification using adaptive dissection and juxtaposition of facet points. It is the integrated approach involving forgery identification process proposes, section-based scheme and key points. First the proposed adaptive dissection process dissects the host image in non-intersecting and adaptively irregular sections. The distinctive points are mined from each section and the distinctive components of the section are combined to identify the LFP that may approximately indicate the SS of being forgery. To discover forgery sections precisely in forgery section mining, we replace the distinctive dots with small super pixels as facet sections and then amalgamates the neighbor sections that exhibit analogous provincial color facets in facet sections for obtaining merged sections. We have demonstrated and proved that efficiency of the proposed process using above experimental outcome. The forgery section is identified by applying an adaptive algorithm on the dissection based on sections and two several key point-based process, i.e., SIFT and SURF. and by mining resilient SURF points of interest and corresponding signifiers. First, feasible duplicate sections in test images may be founded by juxtaposing the signifier vectors. The outcome of the experiment indicates that process quickly identifies copy-move forgery and withstand a variety of transformations and post-dispensation like resizing, rotation, down sampling, jpeg compression and noise attack.

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