Detection and Prediction of Modifications in Medical Images using SIFT Feature Extraction Algorithm

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***Abstract*—This paper proposes a method of digital blind forensics in medical image field. The proposed system detects the global modification of medical images and also finds the nature of the modifications done on the victim medical image. Scale Invariant Feature Transform algorithm used as the medical image feature extraction technique. Scale Invariant Feature Transform descriptors are invariant to illumination differences and it affine present the local features of an image. Keypoints and keypoint descriptor are extracted features from the image, which is input to a vector classifier built in order to detect modifications as well as to identify the nature of the modification. In performance evaluation different types of medical images are analyzed by feature extraction in the proposed system. It shows above 80 percentage modifications detection and Identification rate.**

Keywords— image keypoints extraction,classifier,modification detection

I. INTRODUCTION

The medical image processing field widely developed in resend years. Plenty of new innovations and technologies invented in this area, as consequence of this development software tools are available for Sharing and editing of medical data. This technologies may use in negative purpose, that means a physician or expert can do its own manipulation in the critical medical data using these advanced tools.

The exact problem is that the medical images are manipulated during sharing. The original medical images are modified or altered using advanced medical image editing software, the result of this process is original image changed into modified image. This resultant image may contain disease signs and symptoms or may remove these sins by global changes.

Some of the medical image modifications are detected by DICOM security measures using DICOM indicators in file header of the image, but unfortunately all medical image software or devices are not fully DICOM complaint. Many interoperability and data integration issues are introduced in this field. So the result that image can be shared without proof of their authenticity. So how we can sure that an image received by the hospital is real one? And it is pristine sensor image or a post processed one?

There are many solutions proposed validating the authenticity of an image, "blind forensics" term is the recent technique. They look at the detection of an image modification without any a prior knowledge about the image under observation. A large group of "blind forensics" methods are based on classifier mechanisms built on some image features so as to recognize modification footprints. Most image feature sets from the literature have been first proposed for the steganalysis purpose and next for image authentication but only in the case of natural images. In the proposed system presents image integrity verification framework, which is detects the global modification of medical images and also finds the nature of the modifications. In the proposed system we are using SIFT (Scale Invariant Feature Transform) feature extraction algorithm. This algorithm shows above 80 percentage modification detection rate

The SIFT feature is the local feature of an image, which is invariant to scaling, transformation and rotation of images , and invariant to illumination differences and angle of view changes, affine and noise, Distinctive image features are appropriate to applied to feature matching rapidly and accurately in mass feature database, Even minority of a few object can be extracted to large numbers of SIFT features, Optimized SIFT feature extraction algorithm can meet real time requirement and Extendibility, combining with other features easily. The SIFT algorithm is appt for global modification detection and prediction [2].

II. LIREATURE SURVEY

In this section we are discussing about different existing medical image integrity verification methods, it included method 1 - Proposal for DICOM Multiframe Medical Image Integrity and Authenticity, method 2 - Lossless Watermarking for Verifying the Integrity of Medical Images with Tamper Localization, method 3 - Medical Image Integrity Control and Forensics Based on Watermarking Approximating Local

Modifications and Identifying Global Image Alterations and method 4 - Blind Integrity Verification of Medical Images.
Method 1 is the enhancement of DICOM security measures, especially for multiframe images. Data encryption process provides integrity and authenticity, along with digital signature. The cryptographic operation start with first frame from n-frame medical image, It is signed conventionally. Then, the resulting signature is stored in the DICOM header and used as a key to cipher the remaining frames, generating the ciphered frames and their respective message authentication code (MAC), which will be inputs to generate MMAC, the MAC of the MACs. In next step, MMAC is in turn signed with the private key and the signed MMAC is used as a key to encrypt the first frame. This was done because the frames tend to be similar to each other. The decryption process is very similar to the encryption process. The digital signature is retrieved from the header. Then, the cascading scheme is used to retrieve images along with their MAC, which in turn serve as inputs to generate MMAC. MMAC is decrypted by the public key present in the DICOM header and then used as the key to decipher the first frame, retrieving the initial frame. Finally, the digital signature verified itself [3].

Method 2 is to embed the local authentication information (used for tamper localization) directly into the watermark payload, using only one lossless watermarking system. This method proposes to incorporate such functionality into the lossless watermarking scheme itself. This is achieved by partitioning an image into certain non-overlapping regions and appending the associated local authentication information directly into the watermark payload. The authentication information was distributed in each partitioned block. The tamper detection procedure consists of three basic steps analogous to the local authentication information embedding procedure: Extraction of the block signature, Formation of the block hierarchy, and Verification of the block signature. The watermark payload is extracted using the data extracting and verifying procedure in the region-based lossless watermarking scheme. From the watermark payload, extract the image digital signature and the local authentication information. Decrypt digital signature to obtain the hash value the corresponding public key. Compute the Hash value for the whole image data of the recovered image. Compare it with the hash value. If they do match exactly, the integrity of the image is assured [4].

Method 3 present a medical image integrity verification system that allows detecting and approximating malevolent local image alterations also capable to identify the nature of global image processing applied to the image in this work integrity can be considered as three levels. That is Modification Detection, Modification Location and integrity analysis. The first kind of methods verifies image integrity based on the comparison of hashes computed over the image under investigation or some parts of it with the hashes shared with the image. To localize alterations, one can compute hashes on independent image areas. However, because of cryptographic hash's length, they can be replaced by checksums based on error detection codes

The third strategy refers to blind forensic technique working with no a priori knowledge about the original image. They involve the extraction of some image features that reveal the statistical nature of image modifications. Computed on an image under investigation, these features are provided as input of a classifier that discriminates original images from others modified by global image processing [5].

Method 4 is digital blind forensics integrity verification strategy with the objective to detect whether an image has been modified by any global image modification process. It compares two image features: Histogram statistics of reorganized block-based discrete cosine transform coefficients (HRBD) and Histogram statistics of reorganized block-based Tchebichef moments (HRBT). Both features serve as input of a set of support vector machine classifiers built in order to discriminate tampered images from original ones as well as to identify the nature of the global modification. Once the classifier trained, extract these features from one image under investigation and provide them to the classifier for analysis [1].

A. Obsevation and Analysis

In this section we analyzing the above mentioned methods by some important integrity terms such as Integrity verification of medical images, Global image modification detection, Modification identification, Modification detection rate and Degradation of medical image after applying these method. The table I shows the observation result of reviewed methods.

TABLE .I OBSERVATION AND ANALYSIS OF METHODS

Methods	Observation and Analysis Methods				
	Integrity verification	Global modification detection	Modification identification	Detection rate	Image degradation
Method 1	Yes	No	No	Low	Yes
Method 2	Yes	No	No	Normal	No
Method 3	Yes	No	No	Normal	No
Method 4	Yes	Yes	Yes	High	No

The method 1 is Applicable for both multiframe and single frame medical images. Modification on any of the frames in medical image will be detected. The disadvantages of this method are potential security vulnerability; In addition, if each frame is treated independently, then it will not be possible to detect the deletion of the entire frames. Thus, the dependency introduced by the cascading scheme is also a measure to avoid this weakness. One important issue is selection of initial nonce. It must be something easily obtainable by the verifying party and be unique to avoid using the same nonce for different images. The limitation of this method is it only provide security enhancement to dicom images, it does not discuss any modification detection scheme.

In the method 2 hierarchical structures allows the user to easily adjust the localization accuracy. This hierarchical structure makes the tamper detection efficient. The disadvantages of method 2 is lossless watermarking with low capacity cannot provide enough localization accuracy. If the tampering occurs in the embedding region, it is possible that the watermark decoder could not retrieve the authentication information. Method 2 only concentrating in localized tampering, not in global modification process. It is not identifying any modification nature, only embodying signature to medical image and verifying that signature.

The method 3 provides both global and localized modification theatrical studies in medical images. But not full fill the objective of the work. the disadvantages of this method is Require high embedding capacity and spread the watermark over the whole image introducing risks of interferences with image interpretation. This approach uni-polarity and linearity of the modification model. It is fail to give the right approximation of modification which includes both positive and negative signal variations as those induced by common global image processing. The detection rates are less in method 3 comparing to method 4. The method 4 is digital blind forensics approach. It shows high detection rate and identifying nature of modification comparing to other methods.

III. PROPOSED SYSTEM

The primary objective of the proposed system is detection of global modifications in medical images. Secondarily finds the nature of modifications and predict the modification type. The basic principle of proposed system is extracting image feature from medical images, then extracted features are given as the input to a vector classifier. This classifier results show that, the victim image modified or not. If the image modified then predict the nature of modification.

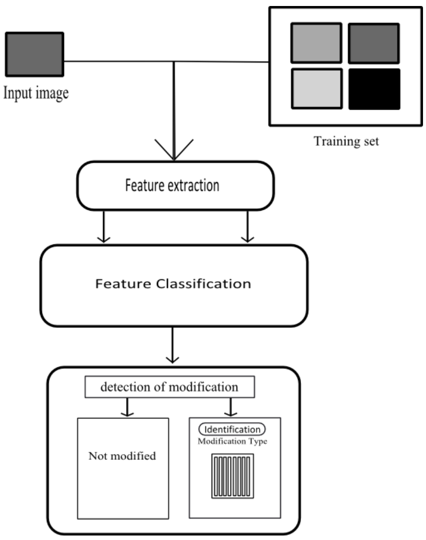

Fig.1 Block diagram of proposed system

Medical image collection is the initial process of proposed work. So we are collected different medical images that are MRI, X-ray etc. In the proposed work we are mainly focus on DICOM images. The Fig.1 shows the block diagram of proposed system

Training set building is the next process. In the training set we used the collected medical images. The accuracy of the modification detection increase with increasing of image collection in training set. In this work we are adding maximum images to training set for excellent result. For better performance of proposed work we have to create maximum training sets of different type of images.

Feature extraction is one of the main processes in proposed system, SIFT feature are extracting from medical images. The SIFT features are invariant to image scaling and rotation, and invariant to change in illumination. They are well localized in both the spatial and frequency domains.

Training a Classifier is the next process in the proposed work. Training a classifier which uses as input some image features normally altered by image modifications. Once the classifier trained, one just has to extract these features from one image under investigation and provide them to the classifier for analysis. Efficiency of such an approach largely depends on the proper image features, and the way the classifier is built. In this system we are design vector classifier for detection of modification. In proposed work the input of classifier is the extracted feature of medical images. Once the classifier trained then it will make decisions. The classifier will detect the test data modified or not. If any modification detected, then it will move to the modification identification system.
The final processing is modification identification system. The input image classified with data set the then result is predict here. The test medical image is modified or tampered it will show that the image is modified and modification nature.

IV. IMPLEMENTATION

Image pre-processing is the initial step in implementation. From the data collection we are selecting deferent type medical images and altering these images in globally. For example the figure image A is an original MRI image of human head section, and image B globally modified image of A, like this we are globally modified all collected medical images. In the proposed work the global modifications are filtering, brightness enhancement, contrast enhancement and noise addition.

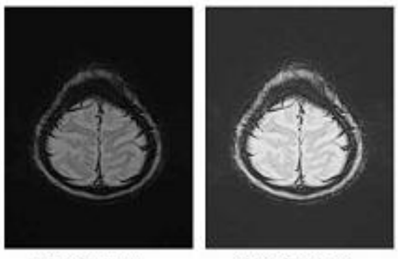

Fig.2 global image modification

Data set creation is the next step in implementation. In the data set we are included above pre-processed medical images. The table II shows the details of data sets in the proposed work.

TABLE .II DATA SETS OF PROPOSED SYSTEM

Type of Images	Body part	No. of Images
MRI	Bran	20
	Head	20
	Spine	20
	Shoulder	20
	Knee	20
X-ray	Chest	20

In the programming view the data set is folder named as "data set" which is loaded into feature extraction function. After the feature extraction of data set it is saves into a variable, the output of the feature extraction is vector form. The same procedure repeated in the test images.

Image Feature extraction is the next step. Image feature extraction is most important process in the proposed work. Extracting image features from data set as well as test image. SIFT is an algorithm in computer vision to detect and describe local features in images.

The features are invariant to image scaling and rotation, and invariant to change in illumination [2]. The Fig 3 shows the SIFT feature extraction algorithm.

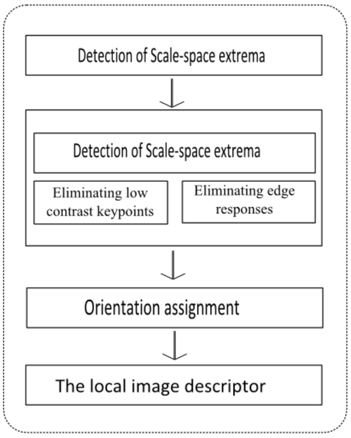

Fig.3. Image feature extraction algorithm

In the SIFT algorithm, first we are converting given image into Grayscale image and applying im2double function to grayscale image for matlab operations. The next process is detecting scale space extreama from the input image, for this purpose we have to generate a multi-scale space image.

In the multi-scale space image we are generating an octave and stored in a variable then a two level pyramids are generated. From the multi scale space image we got key points of image. Then find the magnitude and orientation of the keypoints. The next step is finding keypoint descriptor from keypoints using the magnitude and orientation, for this purpose we to find the keypoint neighborhoods. After that we get both keypoints and keypoint descriptors.

Training a classifier is another main step in implementation process. In this proposed work we are using a vector classifier, to classify the image features. Once the classifier trained then it will make decisions, that the given test image is modified or not.

It is the final step of the implementation. Global image modification nature predicted here. This modification prediction system is integrated with classification system. The classifier's output is input of modification prediction system.

V. PERFORMANCE EVALUATION

A. Method comparison

In this section we are analyzing the performance the proposed method comparing to existing systems.

TABLE .III OBSERVATION AND ANALYSIS OF METHODS

Methods	Observation and Analysis Methods				
	Integrity verification	Global modification detection	Modification identification	Detection rate	Image degradation
Method 1	Yes	No	No	Low	Yes
Method 2	Yes	No	No	Normal	No
Method 3	Yes	No	No	Normal	No
Method 4	Yes	Yes	Yes	High	No
Method 5	Yes	Yes	Yes	Very High	No

In this observation and analysis we are comparing some important image integrity verification based qualities of five different methods. Integrity verification, Global modification detection, Modification Identification, modification detection rate and Image degradation are the quality measures. From this analysis we can clearly observe that the method 5(proposed system) has better performance comparing to other methods. It shows high modification detection rate and Identifying the nature of global modification.

B. Modification detection and prediction

The table IV shows global modification detection and prediction of MRI images of different human body parts (Bran, Head, shoulder and spine) by using the proposed method. This gives average 80 percentage of detection and identification rate.

TABLE .IV GLOBAL MODIFICATION DETECTION AND PREDICTION

Modification type	MRI Images of human body parts			
	Bran	Head	Shoulder	Spine
Filtering	18/20	18/20	18/20	17/20
Brightness	18/20	18/20	17/20	16/20
Contrast	18/20	18/20	17/20	16/20
Noise	19/20	19/20	19/20	19/20

C. Modification identification gragph

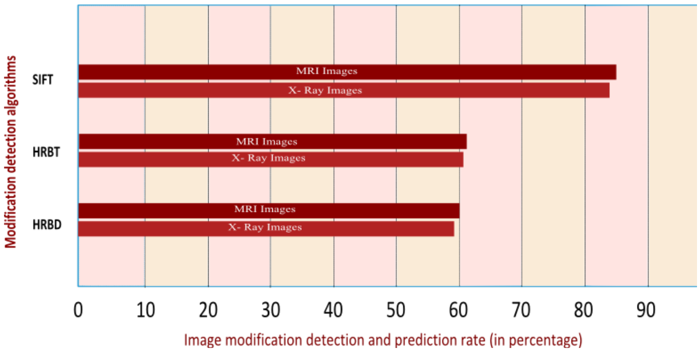

Fig.4. Medical image modification identification graph

The graph (Fig.4) demonstrates medical images modification detection and identification of MRI images and X-Ray images. The graph shows SIFT have better result than HRBD,HRBT feature extraction techniques.

D. Modification detection rate

The table V shows detection rates of HRBT, HRBD, combination both HRBT & HRBD and SIFT algorithm. From these ratings we can say that the SIFT algorithm have better result than HRBT and HRBD algorithms.

TABLE .V GLOBAL MODIFICATION DETECTION RATE

Algorithms	Medical images	
	MRI images	X-ray
SIFT	89	87
HRBT	78	84
HRBD	78	84
HRBT % HRBD	85	85

The graph (Fig.5) shows the detection rates of SIFT, HRBT and HRBD feature extraction techniques. SIFT feature extraction technique have above 80 percentage detection rate.

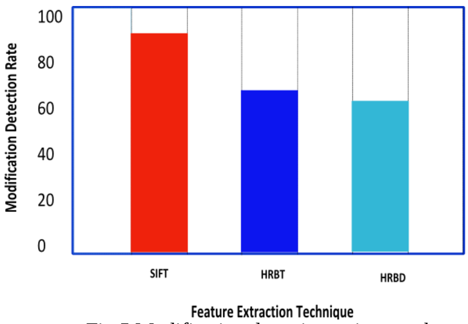

Fig.5.Modification detection rating graph

VI. CONCLUSION

We developed an intelligent system for blind integrity verification of medical images. It is more efficient method for global modification detection of medical images. The proposed system shows higher detection rates comparing to other methods in literature survey.
The proposed system uses SIFT feature extraction technique for extracting images feature from medical images. The keypointes and keypointes descriptors are the final out of SIFT feature. The main steps of the proposed work are image feature extraction, training a classifier, modification detection and prediction of modification type.

The efficiency of the system can be say in terms of modification detection rate and identification rate. The efficiency of system is directly proportional to database collection that is database collection increases then the system efficiency also rises.

VI. FUTURE WORKS

In future work the proposed method can be improve the database collection for absolute identification of modification. Specification in global modification identification is the one of the main future work in the proposed system. For example if the modification was filtering, then specifies the type of filter applied to the medical image.

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