ABSTRACT

Digital image watermarking is the technique, which is used to hide some information within an image to prove its ownership or to authenticate it. The image in which watermark is inserted is known as the host image and after embedding watermark signal in the host image, it becomes watermarked image. The watermark should be embedded into the host image in a way that it should not degrade the quality of the original watermarked image. Watermarking techniques consist of two phases; first phase is the watermark insertion and second is extraction of watermark from transformed watermarked image. Digital image watermarking finds applications in varied areas like defense, medical science, intellectual property right and entertainment.

In literature, various types of watermarking techniques are defined like visible or invisible watermarking techniques; robust, fragile or semi-fragile watermarking techniques and blind, semi-blind or non-blind watermarking techniques. To evaluate the performance of any digital image watermarking technique, it must be compared with already existing techniques on the basis of various parameters like imperceptibility, robustness, security and complexity. This research work deals with the development of improved watermarking algorithms, where improvements are made in terms of imperceptibility, robustness, speed and capacity.

Due to the invariance of ZMs against geometric attacks like rotation, scaling and translation, a number of watermarking techniques based on Zernike Moments(ZMs) are
proposed in literature. In this work, performance of magnitude of ZMs-based watermarking technique and DCT-based watermarking technique is compared and a rotation invariant DCT-based watermarking technique is proposed. The drawback of using ZMs in watermarking is high time complexity to compute ZMs. Further, a robust watermarking technique based on phase of ZMs is proposed in order to improve the imperceptibility of watermarked image and a recursive method namely q-recursive method is used to improve the speed of Zernike radial polynomials computation and thus reduce its time complexity. In our proposed method, ZMs remain stable up to high order as compared to the traditional ZMs computation method, therefore it is possible to insert more watermark bits in the same image and thus the proposed method supports high capacity. Further, as phase of ZMs can be corrected for transformed images, therefore in the proposed method, before extracting watermark, phase of selected ZMs of transformed watermarked image is corrected and this effectively results in zero Bit Error Rate (BER) and high robustness.

A robust watermark authentication scheme based on Weber’s descriptor is proposed that can authenticate the watermarked image, even when it suffers from any geometric or photometric attack. Weber’s descriptor is a descriptor based on two parameters of a pixel, differential excitation and orientation. These parameters are computed using the relative intensity value of neighbor pixels and current pixel. This descriptor remains the same even after intensity changes due to the contribution of all neighbor pixels’ intensity in its computation. It is also known to be robust to scaling and rotation. The proposed method based on Weber’s descriptor overcomes the drawback of Scale Invariant Feature Transform (SIFT)-based watermarking techniques that are not able to authenticate the
blurred watermarked images. The performance of the proposed Weber’s based
watermarking technique is evaluated for both high and low contrast images. Through
exhaustive experiments, it is verified that Weber’s based watermarking can successfully
authenticate the watermarked image for any random bit pattern and for any watermarked
image attacked with compression, flipping, rotation, scaling, translation, change in
sharpness and Gaussian noise etc.

From the literature, it is observed that watermarking finds applications not only in
Intellectual Property Right (IPR) but it can also be used in medical science and military
applications to authenticate the images. A fragile watermarking technique is proposed
that is used to authenticate the medical images and support high capacity embedding with
desirable imperceptibility. In the proposed fragile watermarking technique, pixels that
have low intensity are selected for watermark insertion. These pixels are selected using
Weber’s law. As watermark is inserted only in dark pixels, it has high imperceptibility.
Also, since the proposed technique is fragile, it detects even a small change that is made
to the watermarked image and also locates the blocks where distortion is made. Besides
being able to detect all the malicious changes that affect the quality of watermarked
image, it is tolerant to image compression which is essential to transmit images over the
network. Experimental results are presented to prove the effectiveness of the proposed
watermarking algorithms and to compare them with existing watermarking techniques
used for authenticating medical images.
Finally, the performance of all the methods proposed in the thesis is compared with existing techniques to prove their efficacy. Thus, this work presents a set of algorithms which provide improved watermarking and watermark authentication schemes.