ABSTRACT

In recent years, the unparalleled growth of the Internet has highlighted the need for mechanisms to shield the ownership of digital media. Exact copies of digital multimedia information can be produced and distributed easily. In such a scenario, digital watermarking is a technique that provides an elucidation to the longstanding problems faced in copyrighting digital data. Digital watermarks are pieces of information added to digital multimedia data that can be detected or extracted later for a variety of applications including authentication, copyright protection and ownership verification. Digital watermarking has become an active and important area of research.

A good watermarking system is subject to three conflicting requirements such as imperceptibility, capacity and robustness. Every watermarking technique has trade-offs between these requirements for different applications. The watermarking schemes available in the existing literature are overwhelmed with drawbacks which motivate us to design better and efficient solutions. The major objective of this thesis is the design of three application-specific watermarking schemes. The first scheme is for text documents which is fragile and the remaining two are robust schemes for images. The first three schemes focus on watermark embedding and extraction. But watermark detection is equally important and hence an efficient watermark detector is designed as the next work.

The amount of textual information on the Internet is increasing besides images, audios and videos. Among those media, the text documents lack rich gray scale information, block/line/word patterning and clear separation between foreground and background areas. There is a need for making the text documents tamper resistant against content modification. A secured, invisible approach to authenticate the content and preserve integrity of text documents is proposed. The proposed scheme is fragile and blind with good tamper detection capability. Also, the watermark is resilient to scanning, format change and WinRaR attacks.

The protection of ownership and prevention of unauthorized manipulation of digital images are becoming an important issue. Numerous image watermarking schemes are available in the existing literature. But, they are less robust to various image processing and signal processing attacks. The need for protecting color images is also increasing. A blind and highly robust color image watermarking scheme by combining the advantages of both spatial and frequency domains is proposed. The watermark is embedded in the less correlated low and high frequency bands of the color image in such a way that the perceptual quality of the image is preserved. Imperceptibility is achieved by embedding the watermark in less correlated sub bands and robustness is achieved by spreading the watermark using Laplacian pyramid in contourlet transform. Authenticity is achieved by including the owner identification number as well as an image-dependent user-id in the watermark. The proposed method possesses imperceptibility, authenticity, security and robustness as opposed to the majority of image watermarking methods which focus only on imperceptibility and robustness. Comparisons of the performance of the scheme with some state-of-the-art schemes show that the proposed scheme is highly efficient in all aspects. The scheme can be efficiently used for ownership verification and copyright protection of color images.

With the increased use of 3-D graphics in video games, films, Computer Aided Designs, virtual reality applications, medical imaging, scientific simulations, and cultural heritage, recently 3-D anaglyph images are becoming popular. 3-D anaglyph images combine two stereo images from slightly different view points to a single image. Very little attention has been given in the development of 3-D anaglyph watermarking algorithms. A simple watermarking technique to protect 3-D anaglyph images has been presented. The proposed algorithm takes the advantage of direct processing of the anaglyph images using multilevel 3-D DWT instead of complex RGB processing techniques as in the traditional method. The comparison with the available scheme show the robustness of the proposed scheme against JPEG compression, Gaussian noise, median filtering, sharpening, rotation, cropping, resizing, histogram equalization and many other image processing and signal processing attacks.

The final contribution of this thesis is the development of an efficient watermark detector for images. Not only watermark embedding and extraction plays a crucial role, but also watermark detection is vital in multimedia copyright protection. One of the biggest challenges in watermark detection is the identification of watermark existence even after the watermarked image is subjected to various intentional or unintentional attacks. Another important challenge is to find out whether the watermark is embedded in spatial domain or frequency domain. The proposed detector is robust enough to detect watermarks even from the attacked images irrespective of the image types or embedding domains.

In this study, some issues related to digital watermarking are analyzed and schemes are proposed to overcome them. A fragile text watermarking scheme is designed with an objective of tamper detection. A highly robust hybrid scheme which combines the advantages of spatial and

transform domains is proposed for color images. Due to the growing need of 3-D anaglyph images, a robust watermarking scheme is designed in this work and it can provide ownership verification. Finally, an efficient blind watermark detector is developed to identify the watermarked images in spatial domain as well as transform domain.