

CHAPTER 7

SUMMARY AND CONCLUSION

An important component of any multimedia component is the videos. The tremendous growth in computer hardware, software and network technologies have made it possible to distribute these videos in easy, cost-effective manner, which is a golden benefit to the modern communication medium. In the 21st century, the number of people using video during communication and entertainment has increased tremendously. Recent developments in the communication and transmission medium have revolutionized the method of sharing contents among different users. This has increased concerns on security concerned with copyright violation and illegal copy. Information hiding for digital content protection is an art of science that has been of interest for the past several decades.

The main objective of this research work is to design and develop robust watermarking algorithm for copyright protection of digital video. To achieve this goal, the proposed methods use watermarking techniques. Watermarking, the science of hiding secret data into a digital medium, has gained popularity both academically and commercially.

All the proposed algorithms consist of three stages. The first stage uses visual cryptography and discrete wavelet transformation to create a nested binary watermark as copyright data. In the second stage, the place of embedding is determined and in the third stage, the watermarking algorithm to embed and extract the copyright data is designed. The watermark can be embedded in a video signal in two manners. They can either be inserted before the compression process or after the compression process. This research work considers both the manners.

The design and development of the watermarking algorithms for compressed and uncompressed videos is performed in three phases. The first phase is focused on determining the correct positions to embed the copyright digital data. For this purpose, the video motion vectors are used to determine the motion activity level in video frames. According to this estimate, the frames are classified into five groups namely,

very low activity frames, low activity frames, medium activity frames, high activity frames and very high activity frames.

With uncompressed signals, the motion vectors are determined using an Enhanced Adaptive Rood Pattern Search (EARPS). With compressed signals, the motion vectors are extracted using MPEG format. Only the medium, low and very low activity frames are selected for watermark embedding. Next, each frame is divided into two regions, namely, embed region and other region using edge details and inhomogeneity of a block. The embed region is then classified again using a rule-based procedure as complex, medium and low complex blocks. Two-third of watermark is embedded first with low complex blocks, followed by medium blocks. The complex region is not used during embedding process.

The second and third phases of the research work proposed algorithms to embed and extract watermarks in compressed and uncompressed videos respectively. The second phase uses wavelet packet transformation based on geometric warping with HVS (Human Visual System) based criteria. The algorithm proposes the use of two block selection algorithms, namely, Static Block Selection Algorithm and Dynamic Block Selection Algorithm during the selection of region blocks from Phase I for embedding. Static block selection algorithm inserts watermark in all non-overlapping blocks of pixels in a region. Dynamism in block selection is brought forward through the use of a spatial and feature based clustering method. The extraction operation is the reverse application of steps of embedding operation.

The third phase of the research work focuses on techniques for compressed videos and proposes two transformation-based and one feature-based watermarking techniques. The transformation-based techniques used are Discrete Cosine Transformation, Discrete Wavelet Packet Transformation (DWPT), with Singular Value Decomposition (SVD) and dynamic block selection algorithm from Phase II.

In this study, two techniques for inserting watermarks in uncompressed data and three techniques for inserting watermarks in compressed data were proposed. Experimental results were performed to evaluate proposed algorithms in terms of payload (PSNR), transparency (PSNR), robustness (PSNR, NC), and computation

complexity (speed). Robustness was tested using 13 attacks grouped into six categories. The selected attacks are frame attacks (average, drop and swap), geometric attacks (cropping and rotation), removal attacks (collusion), noise attacks (impulsive and Gaussian), processing attacks (Sharpening, blur and brighten) and compression attacks (JPEG and MPEG).

Experimental results showed that, in compressed domain, the DWPT-SVD model showed better results when compared to DCT-SVD and FPBA algorithms. In uncompressed domain, the WGDBS algorithm worked better than WGSBS algorithm. All the algorithms are resistant to the selected attacks and the results further prove that the proposed algorithms increase security while maintaining the visual quality.

Experimental results also prove that usage of visual cryptography for creating nested watermarks and enhanced transformation and feature selection algorithms with block selection and HVS characteristics are successful in creating robust watermarks in both compressed and uncompressed domains. Thus, it can be concluded that the WGDBS algorithm in uncompressed domain and DWPT-SVD algorithm in compressed domain are efficient in copyright protection and are comparable with the standard quality required for the recent applications like internet and DRM applications.

FUTURE RESEARCH DIRECTIONS

The following points can be considered in future to improve the proposed algorithms.

- The present research considers only copyright watermarking. This can be extended to multiple watermarking, where other applications like authentication can be considered
- The research work, during the design and development of watermarking algorithms for compressed domain, considers MPEG video format. In future, the performance of the algorithm on other video codec standards like avi, H.261 can be analyzed and compared.
- Semantic watermarking is another concept in which watermarks are embedded by modifying semantic objects. Future research can focus on the analysis of semantic watermarking and combine them with the proposed algorithms.