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A Novel Approach for Video Watermarking using MRPSO for Content Security

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Abstract:
As technology is growing, role of digital media becomes productive. Consequently, recording, editing and duplication of multimedia contents happen. Thus protection and illegal use of digital media should be blocked. For this purpose, digital watermarking has become a consideration for the researchers. It is a process of hiding data into carrier signals or frames. Due to this concept online contents can keep safe and protect. There are numerous techniques which have been proposed for video watermarking. In this paper a new technique has been proposed named as MRPSO optimization technique. Evaluations have been performed on the video and results show the performance of the proposed work.

Keywords: *Watermarking, Data hiding, MRPSO (Map Reduce PSO)*

1. Introduction

Due to the rapid growth of computer and network technologies, digital multimedia is becoming more popular and it is very easy to transmit and distribute data. So, there is a demand for techniques to protect the data and prevent unauthorized duplication. Digital watermarking protects the illegal copying of multimedia. A watermark is secret information about origin, ownership, copy control, and so forth. This information is embedded in multimedia content, taking care of robustness and imperceptibly. The watermark is embedded and extracted as per requirement to represent the ownership and/or the identity of multimedia. Digital media files may be text, images, audios, or videos. So, digital watermarking is classified into four types: text watermarking, image watermarking, audio watermarking, and video watermarking.

Video Watermarking is a young and rapidly evolving field in the area of multimedia. Video watermarking can be considered as an expansion of image watermarking. Video watermarking system has more capacity than image watermarking system, so more watermarks that included images and videos can be embedded in the video watermarking system

1.1. Applications of Video Watermarking

Video watermarking is used in many fields for the purpose of security and confidentiality. Some of the applications are as follows:

- Fingerprinting.
- Copyright Protection & Owner identification
- Broadcast monitoring
- Copy protection
- Data Authentication
- Data Hiding (Covert Communications)

1.2. Techniques

1.2.1. Spatial Domain

This is the process of adding watermark to the data. It modifies the pixels of randomly selected data. It hides the data behind the pixels without applying any encryption technique. It uses LSB (Least Significant Bit) algorithm.

- BPCP
  In this segmentation of image are used by measuring its complexity. Complexity is used to determine the noisy block. This technique removes the noise bits from the video and substitutes them with binary pattern which is mapped from confidential information.

- PVD
  In this method, two adjacent pixels are selected for embedding the data. Payload is determined by checking the difference between two adjacent pixels and it serves as basis for identifying whether the two pixels belongs to an edge area or smooth area.

1.2.2. Frequency Domain

It is also known as Transform domain. It uses various frequencies to insert the data or watermark behind the video. It uses domain methods to implement the watermark. Transform domain techniques are broadly classified such as

- Discrete Fourier transformation technique (DFT)
  It replaces the unique functions with frequency components. In case of digital image, the even function refers to the frequency value of sine or cosine functions and then this function is multiplied with the eight values. It generates the coefficient of Fourier transform in the signal.
- Discrete cosine transformation technique (DCT)
  It adds watermarks to a still digital image. In this the image is presented in the form of frequencies of cosine. Then 8*8 blocks of the images considered calculating the DCT of the image.
- Discrete Wavelet transformation technique (DWT)
  It is a technique which is used for embedding watermark behind digital data like image or video. It generates the frequency corresponding to signals. It divides the digital data into three dimensions such as horizontal, vertical and diagonal. The transformation is done on the basis of wavelets.

2. MRPSO

2.1. PSO (Particle Swarm Optimization)

The main idea behind developing the PSO so that information can be shared with the individuals of the population. PSO follows search criterion which is based on the population of the particles [26]. This algorithm is totally based on the exchange of information among individuals in the population whereas individuals referred as particles and population is considered as swarm. Each particle in the swarm adjusts its position according to the previous experience and proceeds to the best previous position in the swarm. By memorizing the best own position in the swarm helps an individual particle to establish its experience which can be implied in local search as well as in global search. Experience can also be gained from the neighboring experience or the experience of the whole swarm [29].

PSO is basically divided into two parts of search such as global neighborhood and local neighborhood. Global neighborhood is defined where each particle moves towards the best previous position or the best particle in the swarm known as g-best model. On the other hand, if particle move towards its best previous position and towards the best particle in the restricted neighborhood in the swarm is known as l-best model.

2.2. MRPSO (Map Reduce Particle Swarm Optimization)

MRPSO technique is a combination of map reduces function and PSO technique. The purpose of using map reduce technique is to perform parallel computations. Map reduces function stores the data in the form of keys along with their associative values. Maps reduce function works in two stages. In first stage it runs only once for every input and at every run it gives an output along with a key value, in second stage the intermediate output is arranged and grouped on the basis of key values.

MRPSO concept is introduced to overcome the disadvantage of PSO as in PSO there is a problem of global Search ability. Following equation is used to calculate the MRPSO:

$$S_i^{k+1} = P_d + \propto \lambda\left(m_{besti} - S_i^k\right) \quad (1)$$

$$m_{besti} = \sum_{i=1}^{s} \frac{P_{best}}{S} \quad (2)$$

S defines the size of the population in MRPSO.

α, is a parameter which varies within the iterations.

In order to calculate P_d following equation is used:

$$P_d = rand_0\, P_{best} + (1 - rand_0)_{g_{best}} \quad (3)$$

3. Problem Formulation

Watermarking is an invisible signature embedded inside an image to show authenticity or proof of ownership. It discourages unauthorized copying and distribution of images over the internet. Thus watermarking tries to hide the text related to the original content of the digital signal. The watermarking should be done in such a way so that the quality of the video does not degrade. But the problem that arises in that image watermarking is very common and there are many algorithms and techniques to encrypt the message. Therefore, there's a need to enhance the security so instead of image we have change the media for watermarking. So as the

information or message is hidden in media file for making it more secure. The techniques of video watermarking that are developed till date like DWT, DCT & DFT had certain disadvantages so need to design new technique was felt. DCT had drawback that it degrades the video quality by increasing the visibility of the embedded watermark. The disadvantage of DWT is that it fails to represent the image effectively. DWT has higher complexity and computation time is also high. So, a new technique needs to be proposed that can overcome the disadvantages of conventional techniques.

4. Proposed System

As we have discussed many of image watermarking algorithms are proposed on basis of spatial domain or transform based. But there are very limited algorithms which supports video watermarking so in this work a new approach for video watermarking is proposed. We all know the main advantage of watermarking is to apply copyright over media or product. So we propose a technique where video as media for watermarking is used for protection or copyright over internet by applying the **Modified PSO** algorithm which actually optimizes the location where the message is to be hidden. Thus, by creating a specific frame through optimization the information is much secured than before.

4.1. Objectives

1. Use of video as media for watermarking instead of Image.
2. Using swarm intelligence algorithm for particular location.
3. Analyses of the result after the use of algorithm.
4. To improve the security and quality of the watermarked video.
5. Watermark to be embedded will be first encrypted to improve the security.
6. Obtained a high quality video after watermarking using proposed technique.

5. Methodology

Block diagram for the proposed technique is as follows:

5.1. Data Embedding

Following is the block diagram which shows the process of embedding digital data in video for the watermarking purpose.

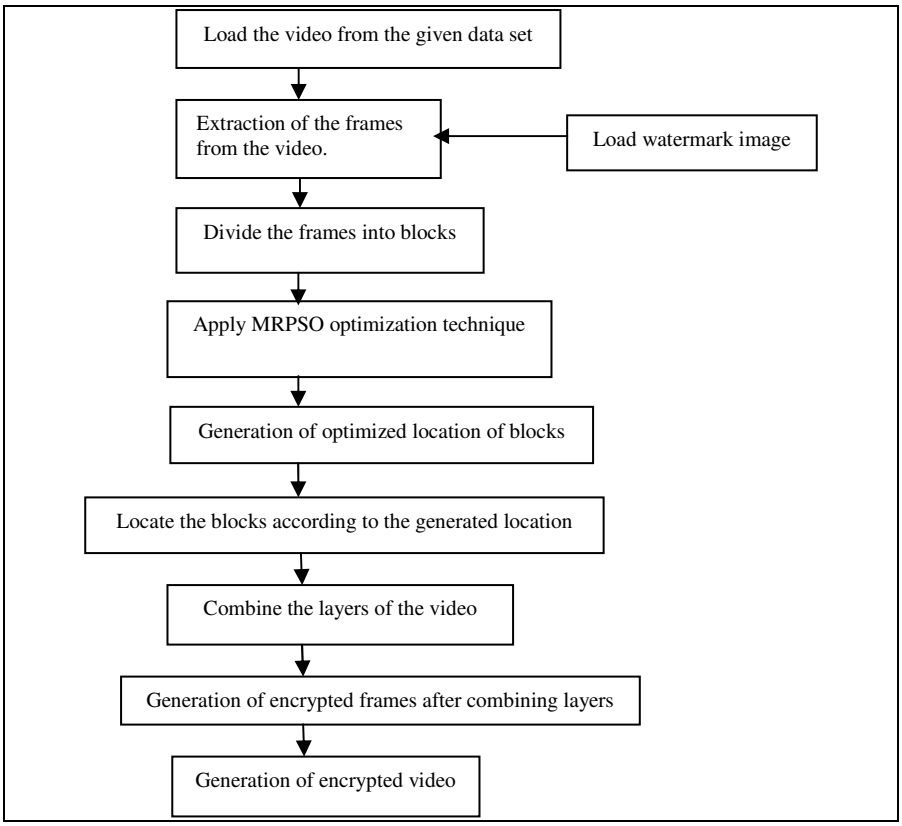

Figure 1: Block diagram for embedding data

The proposed methodology is divided into two sections. One is the embedding of the data into the video and other section is the extraction of data from the video. In this proposed methodology the MRPSO technique is used for the purpose of efficient data hiding.

Methodology of the data embedding process is as follows:

- Select the video which is used as cover for hiding the data.
- Select the image which is going to be hiding behind the video.
- In this step the frames from the video and image is extracted. The image is going to be embedded behind the third layer of the video.
- After frame division, divide the frames of image and video into small blocks.
- Now apply MRPSO for locating the blocks at their optimum location. MRPSO technique generates the optimum location for blocks.
- Now fix the blocks at their location.
- In this step combine the layers of the video.
- After combining the layers, the encrypted frames will be generated. This will lead to the watermarked video, after bringing them together.

5.2. Data Extraction

Following is the block diagram of extracting data after embedding watermarking in video.

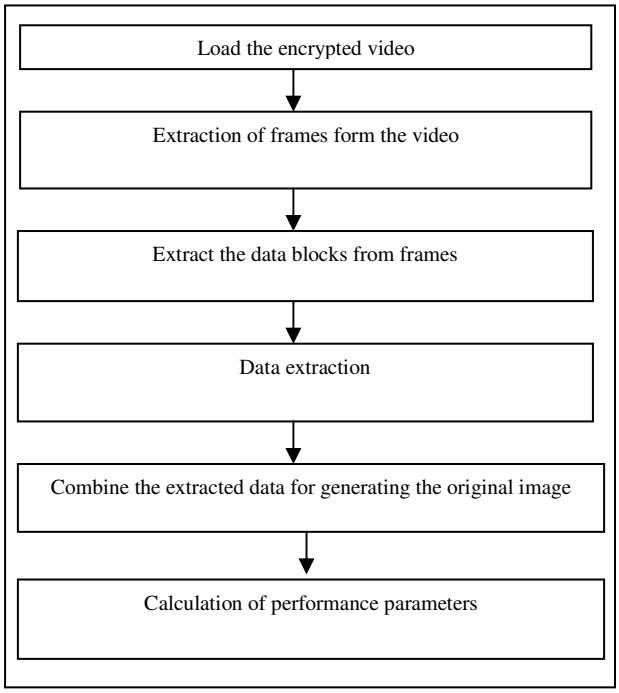

Figure 2: Block diagram for data extraction

After encrypting the data, it needs to be decrypt for the purpose of understanding. The methodology is as follows:

- For the extraction of the data the encrypted video is loaded in which the data is hide by the sender.
- After selection of the video, next step is to extract the frames of the video. These frames are extracted contain the hidden information.
- Divide the frames into small blocks for the purpose of data extraction.
- Extract the data from the blocks.
- Now combine extracted data for generating the original image. Finally, the watermark image is recovered that was send by the user
- After getting the original image, calculate the result parameters such as MSE, BER, NCand PSNR.

6. Results and Discussions

In this section the proposed technique is simulated in MATLAB in order to calculate or measure its performance with respect to traditional techniques. The following results show that how the proposed technique is better than the previous once.

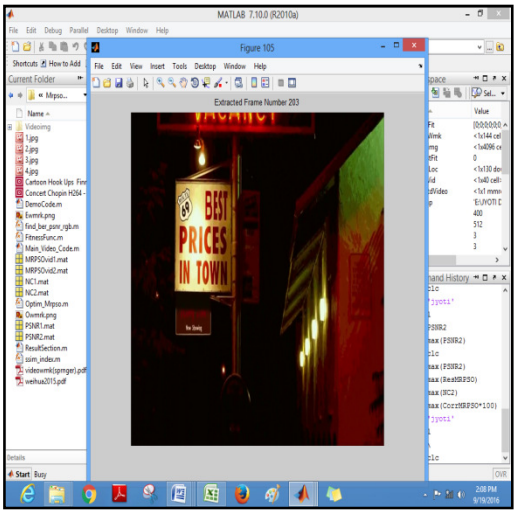

Figure 3: The watermarked video1

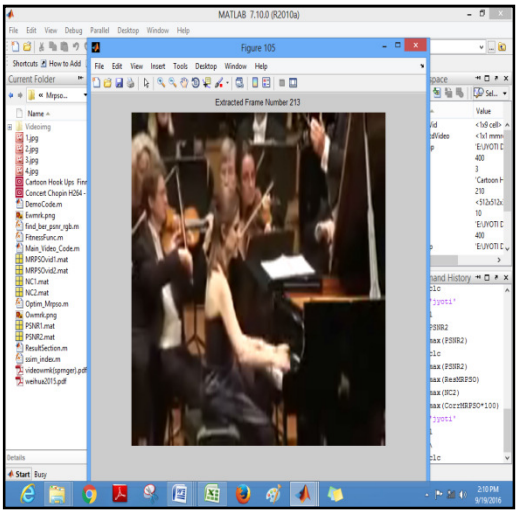

Figure 4: The watermarked video2

Figure 3 and 4 depict the videos which are observed after hiding image behind them. These videos are referred as watermarked videos.

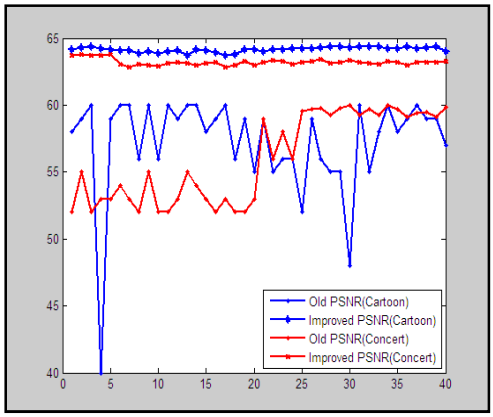

Figure 5: graph for PSNR values of the old and improved technique

Figure 5 describe the comparison between PSNR value of traditional and proposed technique. PSNR stands for Peak Signal to noise ratio. It should be high which shows that the signals are stronger and there are a less number of noises in the signal as compare to data. In this graph the traditional technique and proposed technique is implemented on two various videos one is cartoon and another is Concert. The results of the graph show that the proposed technique has better PSNR as compare to traditional technique in case of both videos.

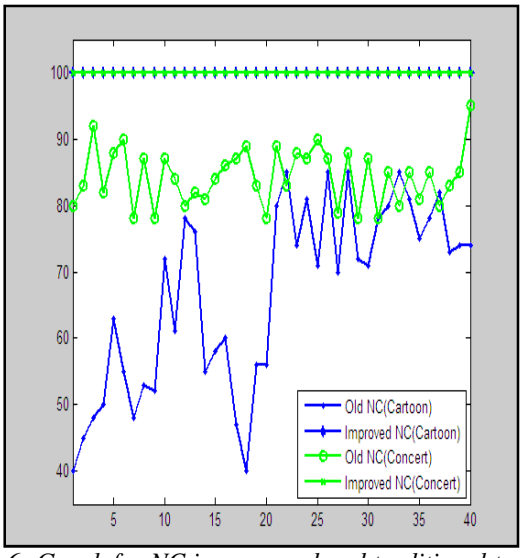

Figure 6: Graph for NC in proposed and traditional technique

Figure 6 shows a comparison graph of NC (Normal correlation) corresponding to proposed and traditional techniques respectively, Normal correlation is the combination of values which is received from the calculation of the Bivariate Normal Distribution. NC of the proposed technique is high as shown in figure above.

Techniques	PSNR	NC
Existing Technique.	60	85
Proposed technique	64.4138	99.9771

Table 1: Represents parameters evaluation using video 1

Ttable1 shows the comparison between the proposed and the old technique performed on video 1. PSNR that should be max i.e. 64 is opting by the proposed technique rather than old one i.e. 60. Furthermore, Normal correlation (NC) of the proposed technique outperforms with 99.9771 as compared to existing which is just 85.

Techniques	PSNR	NC
Existing Technique.	59.9902	95
Proposed technique	63.8256	99.98

Table 2: Represents parameters evaluation using video 2

7. Conclusion and Future Scope

Watermarking is an efficient method of hiding the data in the carrier signal. Watermarking is done to protect the confidential data from unauthorized access. Video watermarking is a process of hiding data in the video frames. The security of the data that is send is the major issue. Traditional many algorithms have been proposed for the video watermarking but the results achieved were not efficient.

It is analyzed that in future further work can be done by using some trending compression technique. This will also increase the security of the data that is the major concern. So in future the work can be done on some other compression technique or by combing the various compression techniques. In addition to this, other data hiding technique can also be used.

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